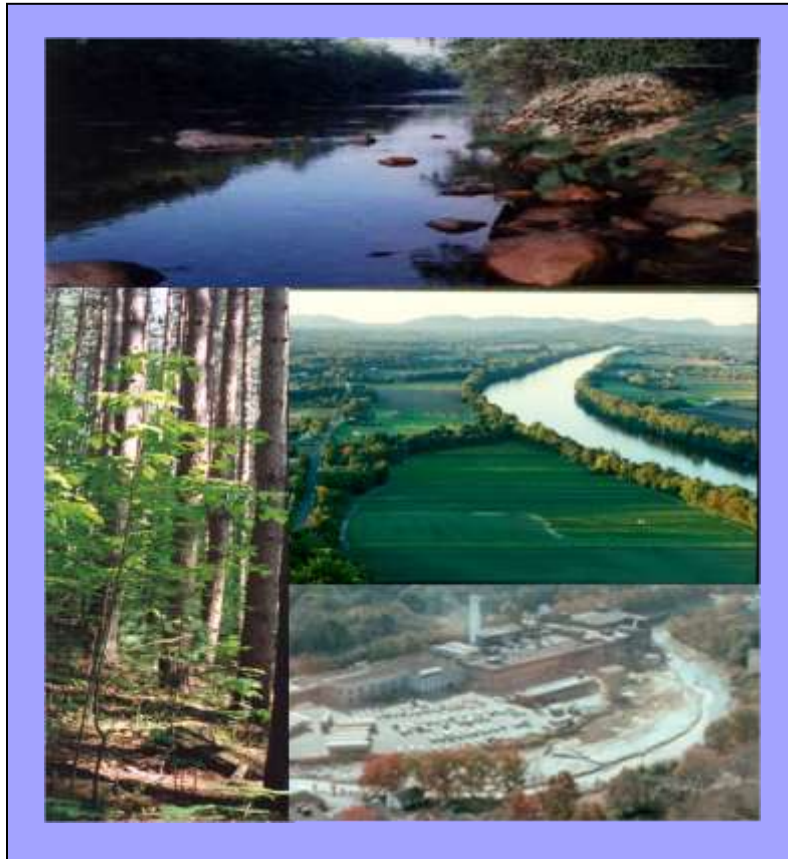


RE-ENGINEERING RESILIENT COMMUNITIES

Using Blue-Green Infrastructure



The Commonwealth of Massachusetts

HUD NATIONAL DISASTER RESILIENCE COMPETITION

Phase II Application – Draft for Public Comment

October 9, 2015



Exhibit A – Executive Summary

Commonwealth of Massachusetts

Ph2ExhibitAExecutiveSummaryMA.pdf

Exhibit A - Executive Summary

The Problem. Communities in MA must become more resilient to events such as the six presidentially declared disasters that occurred in 2011 to 2013. These events caused tremendous damage to infrastructure, housing, environment, and economies. Areas of low- to moderate-income households have found it especially difficult to recover. Municipal infrastructure, and housing were damaged; beaches and riverbanks eroded; and areas de-vegetated. Compounding this need for resilience is the evidence that the climate has changed and is predicted to continue to so do. Temperatures are increasing, sea level is rising and precipitation is more extreme.

Threshold Criteria. To qualify for the National Disaster Resilience Competition, the MA Team demonstrates that 3 “target areas” in MA satisfy the HUD criteria of Most Impacted and Distressed and have Unmet Recovery Needs. These target areas are: the Deerfield River Subwatershed with nine towns of Shelburne, Buckland, Charlemont, Colrain, Greenfield, Rowe, Monroe, Heath, Hawley, impacted by Tropical Storm Irene; Springfield, impacted by five of the disasters; and Williamstown, impacted by Tropical Storm Irene. In addition, all of MA is a target area for resilience planning under this application.

Capacity of the Massachusetts Team. MA has assembled an experienced Team that is eager to assist communities in becoming more resilient. The MA Team, led by the MA Department of Housing and Community Development (DHCD) with project support from the Executive Office of Energy and Environmental Affairs (EEA), includes other state agencies, regional partners (including four regional planning agencies), not-for-profit organizations, universities and local municipalities.

Need and Extent of Problem. Coastal storms, land-bound hurricanes, snow storms, and tornadoes have all ravaged the state; they were particularly devastating to low- and moderate-income communities. Although federal relief funding has helped significantly, it has not covered the total cost of repairing and restoring the damage. The MA Team has developed projects that directly address the impacts and the post-disaster threats remaining as a result of existing unmet recovery needs and potential threat due to climate change. Team Members have been actively addressing these issues through the release of EEA's 2011 Climate Change Adaptation Report, which evaluated strategies to adapt to predicted climate change, and through the numerous vulnerability assessments, adaptation planning efforts, climate resiliency building, and infrastructure fixing projects that the state has funded. It is time to envision and create a more resilient MA with anthropogenic and natural systems better equipped to cope with extremes and new climate change patterns.

Approach. To prepare for this Phase 2 application, the MA Team reached out to local, state, federal, nonprofit, university and private stakeholders. The consultations took the form of emails, phone calls, information sharing, site visits, meetings, and public hearings. Project ideas include: a Plant a Tree program to increase trees in rural and urban areas; a Deerfield River Watershed Resiliency Project that upgrades grey infrastructure, promotes green infrastructure, and ensure long-term resiliency planning; Fix-It-First projects to address impacts from the declared disasters; Reliable Electricity and Heat for Low Income Populations to enable low- and moderate-income populations to gain access to affordable clean energy; and a Mohawk Trail Woodlands Partnership that fosters economic development while protecting forests.

Leverage and Commitments. Direct Leverage of \$18,805,943 is firmly committed and comes from EEA's Greening the Gateway Cities Tree Planting Program, EEA's Department Of

Energy Resources – Community Clean Energy Resiliency Grants for Greenfield and Springfield, EEA’s Department of Energy Resources Pellet Boilers Program, Massachusetts Department of Transportation Resilience Planning in the Deerfield River Watershed, and Massachusetts Department of Environmental Protection funding to the Springfield Water and Sewer Commission. In addition, supporting leverage of \$65,402,319 is firmly committed.

Form HUD2995. Form HUD2995 verifies that this application meets program requirements and supports local Preferred Sustainability Status.

Exhibit B – Threshold Requirements

Commonwealth of Massachusetts

Ph2ExhibitBThresholdRequireMA.pdf

Exhibit B – Threshold Requirements

Meet General Section Administrative Threshold: All Target Areas meet the Threshold requirements outlined in HUD’s FY2014 NOFA for Discretionary Programs.

Eligible Applicant: Commonwealth of Massachusetts

Eligible County: All in MA, including Berkshire, Franklin, and Hampden Counties, were affected by two or more federally declared disasters between 2011 and 2013 and are eligible.

Eligible Activity: Each CDBG-NDR activity proposed is an eligible activity or MA has requested an eligibility waiver for the activity with the Phase 2 application.

Incorporate Resilience: Massachusetts has incorporated resilience into its Phase 2 projects (Exhibit E), and has applied resilience in initiatives listed in Exhibit G.

Meet a National Objective: Massachusetts meets a CDBG-NDR national objective (low- and moderate-income, slum or blight, or urgent community development need) in each Phase 2 activity, with the exception of general administration and planning which is exempt from this requirement, or has requested a waiver from HUD (Exhibit E and Attachment G).

Meet Overall Benefit: At least 50% of the NDRC funds requested in Massachusetts’s Phase 2 application will benefit low- and moderate-income populations in the form of services, area benefit, housing, or jobs in order to meet the national objective of benefit to low- and moderate-income persons, or MA has requested a waiver from HUD.

Establish Tie-Back: Any activity in the Massachusetts Phase 2 application will have a direct tie-back to the six qualified disasters in Massachusetts between 1/1/2011 and 12/31/2013.

One Application per Applicant: Commonwealth of Massachusetts is submitting one application.

Execute Certifications: All required certifications can be found in Attachment C.

City of Springfield Target Area (Attachment E: Figure B-1) is in Hampden County,

determined by HUD to be **Most Impacted and Distressed**

(<http://www.HUDUSER.org/CDBGRDR/AppendixA>) and impacted by FEMA Disaster #1959, 1994, 4028, 4051, and 4110.

Unmet Recovery Needs for Housing. Damage to housing in Springfield exceeds HUD's threshold that 20 addresses of units with remaining damage be provided and that at least 9 of these addresses be surveyed to confirm the damage was due to the disaster and there are inadequate resources from insurance/FEMA/U.S. Small Business Administration for completing repairs. In a windshield survey conducted in February 2015, Springfield identified 14 units owned by the Springfield Housing Authority (SHA) and 26 owned by Hill Homes Cooperative (HUD 202 housing) that were severely impacted by the 2011 tornado, and subsequently demolished. The replacement cost for the 14 units owned by the Springfield Housing Authority is \$3,780,000. With \$1,572,700 in committed funds; this leaves an unmet need of \$2,207,300. The replacement cost for 26 units of HUD 202 housing, the Hill Homes cooperative is \$17,262,465. The development has \$14,788,621 in funding identified, but an unmet need of \$2,473,845. See Dropbox\Exhibit B\ for affidavits of damage and insufficient funding from insurance, FEMA, and SBA for the 40 addresses, as identified by the City of Springfield during the February 2015 windshield survey (SpringHouse1.pdf, SpringHouse2.pdf); photos of these properties (Attachment E: Figure B-5 through Figure B-9); and a MID-URN checklist (SpringMID-URNchecklist.pdf).

Unmet Recovery Needs for Infrastructure. FHWA/FEMA provided \$2,243,855 of the needed \$2,669,830 in funding for "Infrastructure Impacts due to Debris;" unmet need is \$425,975. The

city has determined that it must address debris removal and repair the roadway infrastructure to ensure that these systems are resilient protect against future storms. Storm runoff severely damaged the City's Flood Control Drainage System on Riverside Road, which needs to be upgraded or replaced. The project cost is \$6,000,000 and with \$50,000 from the City, unmet need is \$5,950,000. Total infrastructure unmet need is \$6,375,975. See Dropbox\Exhibit B\ for stamped engineering reports with sources and needs statements (SpringInfra1.pdf, SpringInfra2.pdf), and a MID-URN Checklist (SpringMID-URNchecklist.pdf).

Unmet Recovery Needs for Environmental Degradation. Funding needed to repair the Van Horn Dam, Watershops Pond, Debris Removal and Drainage/Culvert Repair is \$2,770,000.

There is a significant amount of vegetative material throughout the City, especially in undeveloped areas, streams, ponds, and water courses that needs to be removed as a result of the destructive tornadoes which ripped out a 6 mile swath of trees through the city. With \$150,000 of funding available from the City, unmet need for environmental degradation is \$2,620,000. See Dropbox\Exhibit B\ for an engineering report and a sources and uses statement

(SpringEnviro1.pdf); supporting documentation including an Upper Van Horn Reservoir Dam Inspection/Evaluation Report (2009) (SpringEnviro2.pdf), an Inspection/Evaluation Report of the Watershops Pond Dam (2013) (SpringEnviro3.pdf), a report on Vegetative Debris Removal (2011) (SpringEnviro4.pdf); and a MID-URN Checklist (SpringMID-URNchecklist.pdf).

Deerfield River Subwatershed Target Area is in Franklin County and comprises Census Block Groups 250110401001 (qualified during Phase 1 as the "Charlemont Sub-CountyTarget Area"), 250110401002, 250110401003, 250110401004, 250110410001, 250110410002, 250110410003, 250110411001, 250110411004, 250110412001, 250110412002, 250110412003, 250110413001, 250110413002, 250110413003, 250110413004, 250110413005, 250110414001, 250110414002,

250110415021, 250110415022, 250110415023 (qualified during Phase 1 as the “Shelburne Falls [Buckland Portion] Target Area”), and 250110415024. This Target Area includes the entire towns of Monroe, Rowe, Charlemont, Hawley, Heath, Buckland, Shelburne, and Colrain, and much of the city of Greenfield, together which form most of the Massachusetts portion of the Deerfield River watershed, which also extends north into Vermont (Attachment E: Figure B-3).

The Deerfield River Subwatershed Target Area was impacted by FEMA Disaster #4028, 4051, and 4110. On August 28, 2011, extreme rainfall from Tropical Storm Irene caused extreme riverine flows and stream bank erosion starting near the Canadian border and extending through VT, NH, MA and CT, causing significant nonpoint source pollution in the Connecticut River watershed, including its tributaries, the Deerfield and Westfield Rivers, and in Long Island Sound (<http://earthobservatory.nasa.gov/IOTD/view.php?id=52059>).

Distressed Characteristics: 51.23% of the residents in the Target Area earn less than 80% of AMI. Additionally, in Shelburne, 130 of renters had income less than 50% of median and 65% had a severe housing problem between 2007-2011, paying more than half of their incomes on rent, or living in housing that was overcrowded, or without kitchen or plumbing based on ACS data provided by HUD. Between 2008-2012, these figures were 135 renters and 67% (see printout from HUD). There is one brownfield each in Buckland and Colrain, and five in Greenfield (link to Table and Figure). 53.46% of the population of the City of Greenfield earns less than 80% of AMI.

Most Impacted for Infrastructure. Rivers, streams and brooks throughout the Deerfield River watershed in MA and VT surpassed flood levels and rising water gathered debris that clogged culverts. Roads and bridges were washed out and homes and businesses were flooded and, in

some cases, washed away altogether. (See Exhibit D.) Damage from severely high flows in the Deerfield River, resulted in \$12,742,932 in damage to MassDOT's roads, including Route 2, and \$1,803,000 to local roads in Buckland, Charlemont and Colrain, totaling \$14,545,932 (See Dropbox\Exhibit B\ CharleInfraXXXX.pdf). All residents of the Target Area were affected by the closure of Route 2, which provides a critical economic and transportation function, connecting residents to jobs across northern MA and connecting western portion of the state to the east. The Federal Highway Administration (FHWA) spent \$5,632,105 to repair 3 miles of Route 2 in Charlemont. See CharleInfra2.pdf for reports in which FHWA inspected and approved \$1,682,030.25 in cost overruns related to MassDOT Project 606605 – Charlemont & Savoy, Emergency Roadway Stabilization on Route 2 from MM 23.5 (F-05-005) to MM 27.4 (C-05-024 RR Bridge). See CharleInfra3.pdf for pay reports for MassDOT Project 606606 – Charlemont & Savoy, Emergency Repair & Reconstruction of Retaining Walls along Route 2 from MM 23.5 (F-05-005) to MM 27.4 (C-05-024 RR Bridge). The first few pages CharleInfra3.pdf have a cost breakdown that shows \$2,463,556 in retaining wall repair work in Charlemont. In Colrain, the storm caused damage to municipal road embankments and surfaces at North Green River Road, Thompson Road, and Hillman Road (\$204,345, \$116,336, and \$27,149 respectively) (3 FEMA worksheets). The Maxam Raod Bridge abutment sustained \$69,565 in damages (See FEMA worksheet). The wells and electrical system of the Shelburne Falls Fire District, serving portions of Buckland, Shelburne and Colrain, were flooded and the water supply was offline for several days. Cost to move the electrical system and the pump house \$219,000 (provide link to report).

Hawley lost its town garage and fire station, which cost \$209,950 to repair (FEMA worksheet). Hawley also suffered extensive road damages including \$296,088 at Forge Hill Road (FEMA worksheet), \$280,839 at East Road (FEMA Worksheet), and \$461,345 at Buckland Road where Clesson Brook (a tributary of the Deerfield River) washed out portions of the road and its embankment (FEMA worksheet). The town and FEMA also paid \$294,197 to repair damaged portions of East Hawley Road and its drainage system (7 catch basins and a pipe) (FEMA worksheet).

Several roadways were damaged and repaired in Monroe, including River Road, Turner Hill Road and North Road, which the town and MEMA paid \$ 168,820, \$20,090 and \$13,764, respectively to repair (3 FEMA worksheets). This was a huge burden for a community of only 117 people. In Rowe, one timber bridge and five bog bridges were damaged in Pelham Lake Park; repairs were \$22,753 (FEMA worksheet). Flowing water overtaxed a culvert and caused \$49,436 in damages to Tatro Road in Rowe (FEMA worksheet). Heath received approximately \$700,000 from FEMA for extensive damage, including damage to roadways (see overall FEMA spreadsheet listing all Tropical Storm Irene MEMA payments). Buckland, Charlemont, Colrain, and Heath benefited from a Federal Highway Administration grant awarded to MassDOT. From that grant, Heath received \$53,000 for work on Route 8A \$31,000 for work on Avery Brook Road and \$75,000 for work on West Branch Road

<https://www.massdot.state.ma.us/desktopmodules/advancedarticles/articledetail.aspx?itemid=136&moduleid=1030&tabid=367&portalid=0>).

Greenfield, where the Green River discharges to the Deerfield River and the Deerfield to the Connecticut, was heavily damaged during Tropical Storm Irene. Flooding at the Green River

Pumping Station Dam, which impounds a reservoir serving as Greenfield's water supply, caused overtopping and breached the parapet wall, embankment, and corewall, and washed out a 200-ft section of the water supply line (FEMA worksheet). At the Greenfield Waste Pollution Control Plant, the bottom two levels, containing major pumping equipment, were completely inundated by flood waters and extensively damaged. Over 30" of water flooded the main floor of the building housing the process control center, laboratory, and administrative offices (<http://gctv.org/node/381>). The water [pollution control plant underwent a \$9.2 million dollar upgrade – including flood proofing – in 2000 and was designed to withstand floods of 140 feet above sea level; the level Tropical Storm Irene was 142.5 feet (http://www.greenfield-ma.gov/Pages/GreenfieldMA_News/I01783507). Motors powering the pumps in the outlying pump station were destroyed. Costs for repairing the sewage plant were estimated at \$650,000. Greenfield Department of Public Works estimated cost for public works and infrastructure-related repair projects at \$12,495,354.

(http://www.townofgreenfield.org/Pages/GreenfieldMA_Planning/HazMitPlan.PDF). Damage in Greenfield also included damage to Nash's Mill Bridge; its abutments shifted as a result of high river flows. The estimated cost to elevate the bridge and move the abutments out of the water is \$3M. Finally, the Maple Brook Drainage Culvert heaved during the storm, causing increased infiltration and inflow into the sanitary sewer system, which, in turn causes surcharging of sewer and drainage manholes. The estimated cost to repair the culvert is \$2,135,000 (reference AECOM letter report and 3 reports from Don Oullette.)

Most Impacted for Environmental Degradation. Tropical Storm Irene damaged the Shelburne Falls Fire District's water supply wells and eroded the bank along the North River (a tributary to the Deerfield River watershed) in Colrain introducing significant sediment loads to the river and

causing the wells to go offline for 7 days. The water supply provides drinking water to 2,200 residents of Shelburne Falls (located in Buckland and Shelburne) and 50 residents in Colrain. Damages were \$460,000 (DropBox/Exhibit B/ShelFallsEnviro1.pdf). The wells are vulnerable to future flooding and will be a complete loss unless the river bank is stabilized and the well heads are raised.

Unmet Recovery Needs for Infrastructure. There is still considerable unmet recovery need in the Deerfield River Subwatershed Target Area as a result of Tropical Storm Irene. Although \$150,000 in FHWA funds were used to repair the damage to the culvert on Route 2 in Charlemont over Trout Brook (CharleInfra1.pdf, Figure B-4), because the repair work was performed using FHWA funds, the repairs were limited to only what was necessary to restore the culvert to its pre-Tropical Storm Irene condition. The Trout Brook culvert in Charlemont along Route 2 is undersized and restricts natural stream flow, particularly during floods, causing scouring, erosion and high flow velocity. Clogging of the culvert caused washout during Tropical Storm Irene; this could happen again unless the culvert is re-sized. To fully meet the unmet recover need of this disaster, the culvert must be replaced with a large enough structure to pass fish, wildlife and high flows, thereby preventing adverse impacts to important transportation routes and the ecological system. There are no funds available to upgrade the culvert at Route 2 and Trout Brook to avoid future failure and resulting damage to infrastructure and environment. Therefore, the unmet recovery need in Charlemont is the total project cost of \$1,167,000. See Dropbox\Exhibit B\ for an engineering report (CharleInfra4.pdf), and a sources and uses statement (CharleInfr5.pdf). The Shelburne Falls Fire District, serving portions of Buckland, Shelburne and Colrain, must move sensitive electrical controls that run its wells to an upland location in order to ensure that the water supply will not be compromised in the event of another

flood. Cost of this work is \$219,000 (provide link to report and prepare sources and uses statement). Damage in Greenfield included damage to Nash's Mill Bridge when the abutments shifted. The estimated cost to elevate the bridge and move the abutments out of the water is \$3,000,000. However, state funding for this bridge will not be available for 8 to 10 years which causes a hardship to the city. The Maple Brook Drainage Culvert in Greenfield heaved during the storm, causing increased infiltration and inflow into the sanitary sewer system, which, in turn causes surcharging of sewer and drainage manholes. The city of Greenfield is currently designing a new system, however it does not have funding to pay for construction. The estimated cost is \$2,135,000, of which the city has \$135,000 available (reference AECOM letter report and reference 2 sources and uses/engineering reports from Don Oullette.) Total unmet recovery need for the Target Area's infrastructure is \$6,286,000.

Unmet Recovery Needs for Environmental Degradation. The Shelburne Falls Fire District's wells and the bank of the North River that they are situated on are vulnerable to future flooding and will be a complete loss unless the river bank is stabilized and the well heads are raised. This risk to the water supply wells affects portions of Buckland, Shelburne, and Colrain. Additionally, North River in Colrain is affected by the potential for further environmental damage because of the tremendous bank destabilization that occurred during Tropical Storm Irene. Restoration of damage to the well site along the North River in Colrain (Figure B-3) will cost \$460,000. The project includes establishing a riparian buffer and stabilizing the stream bank with a constructed bankfull bench, boulder deflectors, and toe wood structures along 700 feet of eroding bank. No funding is available to pay for this restoration; unmet recovery need for environmental degradation is \$460,000. See Dropbox\Exhibit B\ for supporting documentation including a report from Field Geology Services (ShelFallsEnviro1.pdf), one sources and uses statement

(ShelFallsEnviro2.pdf), and a MID-URN summary checklist (DeerRWaterMID-URNchecklist.pdf).

Town of Williamstown Target Area, of Berkshire County (Attachment E: Figure B-4), was impacted by FEMA Disaster #1959, 4028, 4051, and 4110.

Distressed Characteristics: Census block #25003920101, 65.6% of the residents earn less than 80% of AMI, meeting HUD's criteria for distress. In addition, the entire town of Williamstown is distressed because there are three brownfields in town (link to DEP spreadsheet).

Most Impacted Characteristics for Housing. Flooding from the Hoosic River during Tropical Storm Irene caused massive damage to at least 191 mobile homes in the Spruces of Williamstown. The residential structures were condemned by the building inspector, leaving 273 people, mostly people over 55 and on low incomes, homeless and scattered throughout the region. FEMA found that 128 total housing units in Census Tract #25003920101 had serious damage (<http://www.HUDUSER.org/CDBGDR/AppendixC>). In August 2015, the Berkshire Regional Planning Commission identified 20 housing units with serious damage that are uninhabitable. See Dropbox\Exhibit B\ for property photos (Attachment E: Figure B-__ through Figure B- ____ - dropbox).

Unmet Recovery Needs for Housing

In August 2015, the Berkshire Regional Planning Commission identified 20 housing units with serious damage that are uninhabitable. See Dropbox\Exhibit B\ for property photos (Attachment E: Figure B-__ through Figure B- ____ - maybe add to dropbox instead). Cost to replace the 191 damaged housing units is \$55,500,000. Available funds from others (\$6,445,000) are \$6,130,000 from FEMA, and \$315,000 from HUD CDBG-DR, leaving an unmet need of \$49,055,000. See Dropbox\Exhibit B\ for an affidavit confirming the damage was due to Tropical Storm Irene and

there is insufficient funding from insurance, FEMA, and SBA, as identified by the town of Williamsburg (WilliamsHouse1.pdf) and a MID-URN checklist (WilliamMID-URNchecklist.pdf).

Reconciliation of Unmet Need with Previously Allocated CDBG-DR Funds

DHCD received \$7,210,000 in FY13 CDBG-DR funds of which \$7,118,847 has been spent, allocated, or recommended for approval and \$91,153 is remaining. (See updated FY13 CDBG-DR Action Plan: <http://www.mass.gov/hed/community/funding/community-development-block-grant-disaster-recovery-.html>). The amount remaining is less than the \$400,000 threshold for unmet recovery needs for either infrastructure damage or environmental degradation.

Furthermore, see DropBox/Exhibit B/Spring-MACDBG.pdf for a letter from Mr. Cignoli stating that MA's remaining CDBG-DR funds (as of March 27, 2015) of \$1,249,866 were insufficient to meet the City's unmet needs of \$6,375,975 for infrastructure and \$2,620,000 for environmental degradation.

Exhibit C – Capacity

Commonwealth of Massachusetts

Ph2ExhibitCCapacityMA.pdf

Exhibit C – Need

Phase 2 Factor 1: Capacity

a. Past Experience of the Commonwealth (10 Points)

Massachusetts Executive Office of Housing and Economic Development's Department of Housing and Community Development (DHCD) will provide oversight of this grant contract and its implementation particularly relative to the housing rebuilding projects proposed for Williamstown. The MA Executive Office of Energy and Environmental Affairs (EEA) will provide day-to-day management of grant activities. Staff from EEA developed the projects and wrote this application. The Commonwealth will be supported in project implementation by multiple partner agencies, which are listed in the organizational chart (Figure x) and whose experience and expertise are described in this section.

i. Department of Housing and Community Development: Massachusetts Executive Office of Housing and Economic Development's (HED) Department of Housing and Community Development (DHCD) will provide oversight of this contract and its implementation. DHCD will act as an advisor and technical expert on CDBG requirements. Through its Community Development Unit (CDU), DHCD has successfully implemented the State CDBG program since its inception. CDU staff is well versed in all aspects of the CDBG program including development of the five Year Consolidated Plan and its annual updates; issuance of NOFA's for the distribution of \$30,000,000 on a yearly basis; analysis of applications and oversight and monitoring of grant contracts. Staff provides direct grantee oversight to more than 50 contracts annually, offering technical assistance on how to successfully implement housing rehabilitation

programs, infrastructure repairs, economic development activities and other eligible CDBG activities.

CDBG staff is trained in all compliance areas including environmental review, wage rate monitoring, and procurement. Staff provides technical assistance to grantees in a one-on-one manner, in group settings and formal trainings. Recent training topics have included Davis-Bacon, Lead Paint Abatement, and Environmental Review. The CDU employs an on-line grant management system that provides current information and is critical in collecting and disseminating both outcome and performance data to meet federal and state requirements.

Over the last 8 years, DHCD, through the CDU has successfully developed and implemented Neighborhood Stabilization Program I and III programs and the American Recovery and Reinvestment Act Program. CDU is currently managing a CDBG Disaster Recovery program. Combined, these programs have distributed more than \$70 million in CDBG funds. In creating these programs DHCD was able to build on its already substantial network of public, private and non-profit agencies and valuable experience was gained in coordinating these sectors in the delivery of essential programs and services to the communities and people of the Commonwealth. Both the NSP program and the Disaster Recovery program required DHCD to undertake needs analysis at the local and regional (in-state) levels to determine the best use of funds and to be able to target funds to the most appropriate areas and projects. Development of the Disaster Recovery program involved other state programs as well as federal agencies to best leverage resources and benefit the largest number of residents.

Management Structure: The Community Development Unit (CDU) at DHCD is currently comprised of a Community Development Manager who has 16 years of direct CDBG experience and four direct CDBG staff who each have 10 to 30 years of experience with CDBG and the

management of CDBG contracts. The CDU is also assisted by the Fiscal Compliance Unit which manages the movement of funds and compliance with all OMB requirements. Both CDU and Fiscal staff are familiar with the use of HUD's DRGR database through the NSP and Disaster Recovery programs. Oversight of general staff is provided by the Acting Associate Director who has more than 20 years of CDBG experience at both the state and local level.

References: 1. James M. Mazik, AICP, PVPC, Deputy Director for Operations, Chief Procurement Officer, Community Development Section Manager, 60 Congress Street - Floor 1, Springfield, MA 01104-3419, (413) 781-6045, JmMazik@PVPC.ORG

2. Joseph Laplante, Director, West Springfield Office of Community Development, 389 Main Street
West Springfield, MA 01089, Phone: (413) 263-3045, Fax: (413) 263-3043, jlaplante@west-springfield.ma.us.

ii. **Executive Office of Energy and Environmental Affairs:** EEA is the Secretariat for the state's 6 environmental and energy agencies - Department of Environmental Protection (DEP), Department of Conservation and Recreation (DCR), Department of Fish and Game (DFG), Department of Agricultural Resources, Department of Energy Resources (DOER), and Department of Public Utilities. Staff includes planners, engineers, scientists, economists, grant managers, finance officers, and attorneys. EEA and its agencies have extensive expertise in environmental protection and restoration, clean energy, data analysis, water resources, coastal issues, habitat, forestry, parks and recreation, agriculture, land, fisheries/wildlife, community engagement, design and engineering, climate-related science, wastewater management, drinking water protection, dam repair and removal, planning and implementation. EEA regularly engages

stakeholders in participatory policy and project development and implementation. EEA and its agencies have considerable experience in grant and loan administration and oversight. EEA developed the state's first Climate Change Adaptation Report in 2011 for which it convened over innumerable meetings involving 200 stakeholders. In another policy development process related to resilient ecosystems and water supplies, EEA met with stakeholders over 5 years, and held over 50 committee and workgroup meetings and several targeted stakeholder meetings to develop the complex Sustainable Water Management Initiative (SWMI). EEA has an excellent history of supporting grassroots driven watershed management initiatives and has deep connections with local non-profit watershed groups. In the past year, EEA, and partners such as FRCOG and BRPC held 23 public meetings across the Deerfield River and Hoosic River watersheds and formed a 20-town advisory committee with representatives from each town and 8 regional environmental and business organizations that are meeting to complete a regional conservation and economic development plan. Using its connections throughout the Commonwealth, the MA Team sought stakeholder input through numerous meetings, emails, telephone calls, and public hearings, and provided a 2-week written comment period in order to develop this Phase 2 application. EEA issued a Request for Responses from the public to solicit applications from municipalities that experienced a qualifying disaster, have unmet recovery needs, and desired to be included as a Target Area.

Management Structure: The Secretariat will provide day-to-day management of the projects outlined in this proposal. The key positions directly involved in managing this grant are the EEA Director of Water Policy, an environmental engineer, with 30 years of experience and expertise in managing grants, staff, budgets, schedules and projects. Her project experience includes watershed management, climate change adaptation policy and science, water quality, stormwater,

hazardous waste, wastewater, groundwater and soils, water supply, fisheries, wetlands, land use, habitat protection, combined sewer overflows, policy development, volunteer management, public communication, and economic development. The EEA Assistant Director for Water Policy, a PhD in environmental science and policy, with 15 years of experience in watershed management, policy and planning; water quantity and quality; stormwater and LID; climate change adaptation; dam removal; nutrients management; bioremediation; transboundary water issues; water withdrawals and conservation, and grant management; and an EEA Regional Planner, with experience in dam and seawall, watershed management, project management, grants and fiscal management, website development, and volunteer management. The Land and Forest Policy Director will support the forestry and trees projects in this proposal. He has degrees in forest management and administration and 32 years of experience in watershed management, forest management, land conservation and grant administration and administration of annual capital budgets of \$30-50 million. The planning elements in this proposal will be supported by EEA's Director of Sustainable Development, an AICP certified planner with a Masters Degree in Resource Management. He is responsible for land use policies and programs and serves as liaison to MassDOT and the HED in order to coordinate policies that affect where and how growth occurs, and to encourage development that is consistent with the Massachusetts Sustainable Development Principles and that aids in the Commonwealth's climate change adaptation and mitigation efforts. EEA has a highly experienced fiscal staff that manages on an annual basis over \$800 million. EEA and its agencies oversee many large grant programs, investing hundreds of millions of dollars for land conservation, upgrades to water and wastewater infrastructure, energy resiliency, dam and seawall removal and repair, green infrastructure, coastal resiliency, urban parks, and more. EEA and its agencies of over 2000

people have tremendous depth and will be able to provide additional staff to the project in the case of heavy workload or in the case that key staff is unable to participate on this project as intended.

References:

Four EEA agencies have been tapped for this proposal:

a. The Massachusetts Department of Energy Resources (DOER): is an EEA agency. Its staff consists of program coordinators, analysts, policy experts, attorneys, administrators, and support personnel. The DOER implements policies and programs that promote a clean, reliable, secure, and affordable energy future for Massachusetts. To fund programs and implement policies, DOER manages multiple accounts and trust funds assessed from multiple sources including utilities, the U.S. Department of Energy's (DOE) Sunshot cooperative grant program, and Alternative Compliance Payments (ACP). In fiscal year 2014, DOER managed funds in excess of \$25 million. The Fiscal Office and the Office of the General Counsel monitor and manage fiscal and contract management.

DOER has extensive experience managing large programs dealing with building rehabilitation and development, financing structures, city and regional planning, technical feasibility and engineering, and extreme weather events. For this project, DOER will be heavily involved in the energy resiliency projects and the Mohawk Trail Woodlands Partnership project. DOER's programs have been recognized by the American Council for an Energy Efficient Economy (ACEEE), ranking Massachusetts the leader in the nation for energy efficiency policies. These policies include the Leading by Example (LBE) program which partners with state-owned buildings and the Pathways to Net Zero Energy program which funds both residential and commercial demonstration projects. The Mass Save HEAT loan program support

lenders to provide loans for energy efficiency upgrades and solar panel purchases. The Community Clean Energy Resiliency Initiative funds both technical and engineering feasibility studies, and examines the potential impacts of extreme weather events.

Reference: For SAPHIRE programs: Alice G. Dasek, Energy Efficiency & Renewable Energy, U.S. Department of Energy, Office: 202-287-1595, Cell: 202-308-0894, E-Mail: alice.dasek@ee.doe.gov.

b. The Division of Ecological Restoration (DER): is a division within EEA's Department of Fish and Game that works with community-based partners to restore aquatic ecosystems. The Division's ecological restoration work brings clean water, recreation opportunities, healthy commercial fisheries, and other ecosystem services to the citizens of Massachusetts. DER has extensive experience developing and leading local partnerships to implement on-the-ground ecological restoration and construction projects in the riverine environment, including dam removals, bridge, and culvert replacements. Staff is highly trained in the use of improved standards for culvert replacements, and bring specialized expertise in aquatic science and water resource project management to culvert replacement, including fieldwork, project planning and coordination, engineering, permitting, monitoring, and construction. Staff has significant experience with grant writing, outreach, and community training. DER is currently managing approximately \$15 million in U.S. Department of Interior Hurricane Sandy Coastal Resiliency grant funds for water resources projects. DER has completed more than 50 large-scale water resources improvement projects and has developed significant grant and project management capacity. Technical and fiscal staff has extensive experience managing federal grants and is well-versed in required tracking, monitoring (metrics), and reporting. DER's fiscal staff is also well-

versed in state procurement procedures and has an efficient process for receiving, contracting, and disbursing grant funds.

Management Structure: The key position for managing DER's day-to-day involvement in the Culvert Replacement program will be Timothy Chorey, Environmental Analyst III, DER's water resources construction expert for the DER Stream Continuity Program. Mr. Chorey coordinates community capacity building for improving culvert design and construction, and provides direct technical assistance for the engineering, design, and construction of upgraded culverts. Also contributing will be Kris Houle, Environmental Analyst III, a water resources engineer who is an environmental restoration project manager, who also assists communities with engineering review, site-specific hydrology, and construction oversight. Megan Sampson, Program Coordinator, is responsible for contract administration for technical services, cooperative agreements, outreach, and grant administration.

c. The DCR Office of Water Resources (OWR) falls under the EEA, and serves as staff to the Massachusetts Water Resources Commission. It provides science, policy guidance, and technical assistance on water resources issues. Within OWR, the Flood Hazard Management Program (FHMP), the State Coordinating Office for the National Flood Insurance Program (NFIP), has engineers and planners who provide technical assistance to communities, other state agencies, engineers, architects, and property owners; and administer the Commonwealth's hazard mitigation planning and grants programs through close cooperation with the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA). In 2013, OWR staff ensured the Commonwealth's continuing eligibility for Federal disaster assistance and hazard mitigation grant funding to state agencies and communities by

updating the State Hazard Mitigation Plan in cooperation with MEMA. That same year, DCR and MEMA submitted grant applications to FEMA for over \$12 million in hazard mitigation grant projects.

OWR's Hydrologist and Geologist operate the statewide rainfall network in partnership with volunteer observers at 150 stations to provide critical data and track trends over time; analyze and report monthly on statewide hydrologic conditions; cooperate with the United States Geological Survey (USGS) to provide timely scientific research, and operate the state's hydrologic monitoring network of real-time streamflow, groundwater levels, snowpack, and soil moisture in coordination with local National Weather Service Forecast Offices and NOAA's Northeast River Forecast Center, and; participate in the MEMA's Emergency Support Function Team during flood events. During Tropical Storm Irene, our staff was activated to 24/7 status for emergency assistance- helping communities to predict when, where, and how much flooding will occur and disseminating information to local emergency managers. The USGS Cooperative Program annual \$800,000 budget is managed by OWR staff, as well as with the Office of the State Geologist at the University of Massachusetts. The Hydrologist and Geologist also routinely manage multi-year interpretive studies with USGS.

Reference: Keith W. Robinson, U.S. Geological Survey, Director, New England Water Science Center. kwrobins@usgs.gov Phone: 603-226-7807 (NH desk); 508-490-5115 (MA desk).

d. The Massachusetts Department of Environmental Protection (MassDEP) is the state environmental regulatory agency within EEA responsible for ensuring clean air and water, safe management and disposal of solid and hazardous wastes, cleanup of hazardous waste sites and spills, and the preservation of wetlands and coastal resources. MassDEP conducts approximately

6,650 inspections per year, and in 2014, undertook 2,965 lower level enforcement actions, 706 high-level enforcement actions, and independently assessed about \$2.11 million in administrative penalties. MassDEP also reviews more than 8,000 environmental permit applications each year and maintains an excellent track record for timeliness by conducting 99% of permit reviews on-time, and issuing permitting decisions for 97% within 180 days.

MassDEP is committed to addressing climate change throughout its programs. One of MassDEP's newest programs, its Water Utility Resilience Program (WURP) provides technical assistance (TA) to support drinking water (DW) and wastewater (WW) utilities develop or enhance their resilience to severe and hazardous weather events. WURP was established to identify helpful and practical resources, identify opportunities for local and regional partnerships, provide adaptation planning, asset management and vulnerability assessment assistance, and coordinate training opportunities for DW and WW facilities. Currently WURP is working with partners on revising language to a guidance that identifies new elevation information and storm resiliency design considerations for DW and WW facilities; supporting a workshop that brings together consulting engineers, DW utility managers, and state regulators to brainstorm potential revisions to the current DW design guidelines so that energy efficiency and climate change adaptation are considered when building or renovating drinking water infrastructure. MassDEP has been administering the State Revolving Fund (SRF) for 25 yrs; it provides low and no-interest loans to municipalities for improvements to water infrastructure. Over the last generation, communities have used SRF programs to finance more than \$6 billion in grants and loans to build wastewater and drinking water treatment plants, rehabilitate pumping stations, upgrade water mains and install green infrastructure at these facilities. In 2014, the SRF issued

\$542 million in loans to 54 cities, towns and regional water supply and wastewater treatment districts for 80 different projects.

References:

PARTNERS:

The MA Team has a strong capacity to work regionally as demonstrated by the MA Climate Change Adaptation Report development process that was developed using input provided by stakeholders from all across the state on the impacts of climate change on various sectors and on potential adaptation strategies; the SWMI process which teamed biologists with water suppliers, municipalities, academics and state agencies to develop ecologically-based water withdrawal criteria; the 4 HUD Sustainable Regional Plans that used grassroots engagement to address regional land use, natural resources, economic development, equity, and infrastructure problems; and the Deerfield/Hoosic natural resources and economic development initiative which involved coordination of 2 regional planning agencies as well as local grassroots organizations with state and local government and non-profit organizations. While the Team may implement specific HUD-funded recovery measures in the target areas, the Team partners will promote resiliency project results, strategies and tools in these target areas and throughout the entire state. Our partners include:

MA Department of Transportation (MassDOT): will implement projects related to state-owned road crossing infrastructure and provide design and technical advice on matters related to highways, bridges, culverts, public transit, infrastructure vulnerability public works, environmental quality, design and engineering. The Project Development Section within the Highways Division of MassDOT oversees roadway and bridge projects. MassDOT Project

Managers will be responsible for supporting the advancement of each project through the design phase in accordance with all applicable federal, state and local requirements relative to design criteria, environmental regulations and property rights, or Rights of Way. They routinely work closely with municipalities throughout design processes. MassDOT ensures that all construction complies with the Highway Division plans and specifications, that construction proceeds safely and in accordance with established schedules and budgets. MassDOT employs a robust and efficient project development process that lends itself well to the rapid design and launch of projects when necessary and appropriate. This is demonstrated through their Accelerated Bridge Program launched in 2008 where over the course of the eight year program, more than 270 bridges will be repaired or replaced. As of September 1, 2015, MassDOT ABP has advertised 198 construction contracts with a combined construction budget valued at \$2.46 billion.

Technical Capacity: MassDOT possesses wide-ranging technical capacity through the diverse and complex roadway and bridge capital improvement program. MassDOT oversees all roadway and bridge projects within the Commonwealth which receive federal aid from the USDOT. Projects designed by MassDOT and municipalities complement state, city and regional planning goals and address the most pressing needs of the community. MassDOT evaluates a number of risks and criteria for inclusion in a project design, including traffic, safety, operations, climate and emergency services. The project manager coordinates with several of the Divisions within MassDOT, including but not limited to Environmental Services, Hydraulics, Landscape, Right of Way, Utilities, Engineering District staff and Highway Safety to arrive at the most safe and cost effective design that promotes environmental stewardship and protection of resources within the project area.

MassDOT conducts technical reviews of roadway and bridge projects to avoid, minimize and mitigate impacts to the environment and enhance resiliency and habitat connectivity where possible. It also ensures that its roadway and bridge projects will not adversely affect a floodplain by conducting hydraulic analysis of the proposed design to determine if upstream or downstream impacts will occur or compensatory flood storage so the project does not result in a loss of overall flood storage at each elevation. Where feasible, MassDOT incorporates green infrastructure on roadway, bridge and culvert projects. MassDOT regularly engages the community and key stakeholder groups during the development and design of highway projects to solicit comments and field questions. Public involvement can range from a minimum of a design public hearing to a full community engagement process. When appropriate or when requested, MassDOT provides translations of public announcements and certified translators at the Design Public Hearings.

Examples of Previous Projects: 1. Culvert Replacement on Route 2 Over Hartwell Brook (Bridge No. C-05-025) in Target Area, Charlemont. This project replaced the existing box culvert with a 32-foot single span pre-cast arch structure, increased the bridge low chord by approximately two feet above the 10-year flood stage elevation, removed the concrete stream bed, restored it with natural streambed material similar to the native substrate found upstream of the structure, placed riprap over the spread footings for scour protection, restored the streambed, and created a low flow channel was created to provide aquatic organism passage during summer months and other periods of low flow.

2. Emergency Repair and Reconstruction of Retaining Walls along Route 2, Charlemont and Savoy. MassDOT conducted emergency repairs to restore the safety and operational capacity of the transportation infrastructure for Route 2 in the Berkshire region by removing guardrails,

constructing an access road to the water's edge, using deposited riverbed material to create berms, repairing slope, placing gravel fill over geotextile fabric, placing riprap over the gravel and reconstructing slopes to match the existing slope grades and limits.

Management Structure: Environmental Services employs a broad range of environmental analysts with focus areas spanning climate, wetlands and waterways, state and national regulatory frameworks such as the Massachusetts Environmental Policy Act and the National Environmental Policy Act, hazardous materials remediation and historical and cultural resource protection. Key staff positions that will be integral to the implementation of the proposed Deerfield Watershed Culvert Project and other road/bridge projects include a Project Manager, a Hydraulics Engineer, a Geotechnical Engineer, a Wildlife Biologist, and an Environmental Analyst.

Massachusetts Department of Public Health (DPH): a state agency, is on the forefront nationally in assessing and preparing for the health impacts of climate change including promoting adaptation planning at the local level. DPH was a key participant in the MA Climate Change Adaptation Study and co-chaired the subcommittee on Health and Human Welfare along with MassDEP. These efforts have resulted in collaborations and partnerships across local health departments, municipal officials, regional planning agencies, and state and federal agencies focused on climate change. DPH is a pioneer in the use of Health Impact Assessments (HIAs) as a tool for community engagement when incorporating health-based perspective into policies, programs, and projects outside of the traditional realm of public health. DPH developed an innovative approach that integrates the Centers for Disease Control and Prevention's (CDC) BRACE and HIA frameworks that provides a broader perspective on the importance of climate

preparedness in addressing potential public health impacts of climate change. DPH works closely with local health and municipal officials to assist in the implementation of public health programs aimed at reducing environmental health risks, chronic diseases, and preventing, responding and recovering from natural disaster events. It engages directly with communities using funds from CDC, private foundations (e.g., RWJ, Kresge), and trusts on various programs. Funding from HUD will provide an opportunity to further assess the effectiveness of these programs at the community level and recommend ways to improve community health resilience at the local level and better prepare for future climate impacts.

AECOM: will provide technical support in the management and delivery of funded projects and programs. AECOM has over 500 staff in Massachusetts with technical expertise in all aspects of climate change and resiliency. AECOM's community resilience, climate adaptation, architecture, engineering as well as grant program and public outreach experience combined with our history of working with agencies and communities across the state will greatly aid the success of MA's NDRC Phase 2 projects. AECOM has identified a team with significant experience in the following areas: developing project designs; progressing from design to permit approval; climate adaptation and resilience planning; coordinating with municipal governments; gaining public input and support; working with HUD financed projects; and benefit-cost analysis (BCA) of project concepts.

Our team's project experience includes: New England Regional Catastrophic Planning Initiative; City Disaster Resilience Scorecard Stamford, CT; CDBG DR Community Reconstruction Planning in New York City and Long Island, NY, Benefit Cost Analysis Toolkit – Decision Making Supporting Tool for Hazard Mitigation Assistance; Adaptation and Planning

Strategies to Mitigate the Impact of Client Change Induced Sea Level Rise, Flooding and Erosion at Selected Defence Sites; and Rockefeller 100 Resilient Cities Program Strategic Partner.

Reference: Franki Coons, Chief Grants Implementation Branch, FEMA,
Franki.Coons@fema.dhs.gov, Phone: (202) 646-3079

The Franklin Regional Council of Governments (FRCOG): is a political subdivision of the State of Massachusetts and the Regional Planning Agency (RPA) for Franklin County, Massachusetts. The FRCOG works with towns in the Deerfield River Subwatershed Target Area including Colrain, Heath, Charlemont, Hawley, Buckland, Shelburne, and Greenfield. The FRCOG has a long, successful history of working with its communities and other organizations and agencies in the region and across the state. As the RPA for Franklin County, they provide housing, transportation, land use, natural resource, and economic development planning services to our communities. In addition, they provide extensive GIS database development, mapping, and analysis services and are an affiliate of the Massachusetts State Data Center. FRCOG provides procurement, finance, and other services. The FRCOG has developed regional plans for housing, economic development, transportation, energy, natural hazard mitigation, and watersheds in collaboration with other regional and state agencies and Franklin County towns.

FRCOG recently completed a HUD-funded Regional Plan for Sustainable Development for Franklin County and Multi-Hazard Mitigation Plans for 23 towns. The FRCOG has a total annual budget of \$6.5 million and 47 staff. In FY15, they managed \$3.6 million of federal funds. Currently, the FRCOG is a Cooperative Agreement recipient with the U.S. Environmental Protection Agency and manages a Brownfields Assessment Grant and a Revolving Loan Fund.

FRCOG administers a grant from the U.S. Economic Development Administration for regional economic development planning for the greater Franklin County region. The FRCOG has over two decades of experience managing federal funds and has secure financial management systems in place. It is audited annually by an independent CPA firm in accordance with the requirements of OMB Circular A-133 and the government auditing standards issued by the Comptroller General of the United States. There were no material weaknesses or deficiencies identified in their FY2014 audit report.

Management Structure: The FRCOG Council is the oversight board of the Franklin Regional Council of Governments. Its primary role is to oversee the projects and activities of the 13 different programs and services provided by the FRCOG, adopt policies, and develop and endorse the FRCOG's annual operating budget. The FRCOG Council is a 29-member board made up of a Select Board member or assigned representative from each member town (the 26 towns of Franklin County), two Regionally Elected members that hold three-year terms, and one representative of the Franklin Regional Planning Board, which acts in an advisory capacity on planning issues to the FRCOG. The FRCOG Planning Department will be involved in implementing the green infrastructure, planning and outreach projects in the Deerfield River Subwatershed. Key management positions in FRCOG include the Director of Planning & Development, and the Land Use & Natural Resources Program Manager who will manage FRCOG's day-to-day involvement in task implementation.

References:

The Pioneer Valley Planning Commission (PVPC): is the designated regional planning agency for the Pioneer Valley Region of Western Massachusetts, which includes Springfield and is a

consortium of 43 local governments that addresses problems and opportunities that are regional in scope. PVPC's staff of planning professionals works with community leaders and public agencies and officials to define and direct solutions to area-wide problems that cannot be solved by member communities alone. PVPC's professional planning staff includes experts in environmental planning, land use and zoning and GIS.

PVPC has undertaken and managed several large scale projects including: a \$4.2 HUD Sustainable Communities grant with Capital Region Council of Governments (CRCOG) to develop a regional sustainability plan - Our Next Future; developed Valley Vision 2, the region's innovative land use and smart growth plan; coordinated seven-municipality efforts to cleanup Combined Sewage Overflows (CSOs) and administer over \$20 million in US EPA grant monies; created a Clean Energy Plan for the Pioneer Valley. PVPC staff has extensive experience in facilitating public meetings, including public discussion of environmental issues, and engaging community members and stakeholders, especially under-represented and vulnerable populations, in planning processes; GIS mapping with two full time GIS professionals and two graphic publication professionals. PVPC has developed expertise in disaster resilient recovery planning and assisted the communities of Monson, West Springfield and Springfield with disaster recovery planning after the TORNADOS. Since 2005 PVPC has facilitated local Hazard Mitigation planning efforts and is currently developing a hazard vulnerability assessment tool designed to be a high-level assessment or screening tool to better understand which transportation and water infrastructure assets are vulnerable to the current and probable future impacts of climate change.

Management Structure: Timothy Brennan is the Executive Director and provides overall direction to PVPC. Their chief planner, Christopher Curtis, will support planning and public involvement aspects of this project in the Springfield area; supported by Catherine Ratte,

principal planner, senior planners Jaimye Bartak and Patty Gambarini, and GIS specialist Jacob Dolinger.

References: Mary Ellen Kowalewski, Director of Policy and Planning, CRCOG, 241 Main Street, Floor 4, Hartford, CT 06106; phone: 860.522.2217 x 222; www.crcog.org.

Berkshire Regional Planning Commission (BRPC): the regional planning agency for Berkshire County, the western most county in MA, assists thirty-two cities and towns on topics including community and economic development, community planning, data and information services, emergency preparedness planning, environmental and energy planning, regional services, public health planning and services and transportation. Working with a professional planning staff and a citizen commission, BRPC collaborates with its member rural and urban communities works to enhance the regional resilience and quality of life in the region. Per federal mandate, BRPC is responsible for major regional transportation planning programs and projects in our region, and is also responsible for regional review procedures as required by various federal and state programs. BRPC has professional staff and uses consultants to provide direct technical assistance to municipalities. The Commission consists of one member of the Planning Board of each member city and town. Work is typically done by standing committees of the Commission, comprised of delegates, alternates, and, in some cases, members from outside BRPC. They are the executive committee, environmental review, finance, commission development, and regional issues committee.

Deerfield Creating Resilient Communities Group (CRC): Another local stakeholder group in the Deerfield River Subwatershed is the CRC group. This volunteer group will play a vital role in communicating needs, highlighting priorities, coordinating with local stakeholders to obtain

broad community representation in the public involvement process, and working across political boundaries in the subwatershed. The CRC consists of federal and state agencies, municipalities, environmental groups, UMass Amherst researchers, and residents from both Vermont and Massachusetts. CRC has initiated a number of efforts to advance the assessment and restoration of the Deerfield River watershed. CRC mapped and provided preliminary information about culverts with chronic, storm-related problems in the Massachusetts portion of the Deerfield River watershed.

Trout Unlimited (TU): is a national non-profit organization. TU has worked with federal, state, and municipal partners and private landowners to conserve and restore cold water and headwater streams in Massachusetts since 2009. Over the last six years, the New England Culvert Project (NECP), a regional division of TU has assessed over 4,000 publicly owned road-stream crossings, replaced 22 degraded crossings on public-access roadways, removed one dam, reconnected over 60 miles of fragmented brook trout stream habitat, and completed in-stream large wood habitat restoration in over 20 miles of degraded stream channels on private lands. Their methods are based on a combination of green and grey water management projects including stream bank stabilization, in-stream wood installation, and culvert and bridge repair or replacement. TU has developed a suite of aquatic organism passage, geomorphic, and hydraulic capacity models used to assess vulnerability and prioritize road-stream crossing infrastructure restoration.

Recently, TU led the effort to assess road-stream crossings throughout the Deerfield River watershed - 1,072 in Massachusetts and 720 in Vermont. TU plans to continue to be involved in undersized culvert replacements, stream bank stabilizations, in-stream wood

installations, and riparian forest management to decrease erosion, reconnect the river to its floodplain, dissipate stream velocity during storm events, decrease infrastructure vulnerability, and connect critical coldwater stream habitat for native aquatic species. TU will be invited to participate in the green infrastructure implementation project in the Deerfield River Subwatershed.

Management Structure: The restoration and conservation work provided by TU-NECP is initiated, overseen, and completed by a project coordinator and field manager while the larger mission of the work is dictated by the national organization. On-the-ground implementation of conservation and restoration work is carried out by trained field technicians and interns, all of whom are overseen by the field manager. Because TU is a member-supported organization committed to local action and participation, volunteers may also participate in field work if it is deemed safe and appropriate.

Reference: Erin Rodgers, Ph.D., Research and Field Manager, Trout Unlimited, 54 Portsmouth St, Concord, NH 03301, email: erodgers@tu.org, 603-852-8110.

The Trust for Public Land (The Trust): Established in 1972, The Trust is a national nonprofit organization that has created 5,000 new public places that serve over 7 million people within a 10-minute walk, including several urban greening projects in cities across America. Their mission is to create parks and protect land for people ensuring healthy, livable communities for generations to come. They have expertise in the fields of real estate, public finance and research, urban planning, and GIS innovation. For the last 35 years working in MA, they have led voter-approved finance measures generating over \$2B in new public funding for parks, open space, trails, and public access. Their research in 2013 demonstrated that the Commonwealth's

investment in open space returned \$4 in benefits for every \$1 invested. In 2010, The Trust launched the Climate-Smart Cities(tm) program to develop multiple-benefit natural areas that perform important functions for cities.

Targeted at carbon mitigation, resilience, and vulnerable communities, this program is organized for climate-smart urban greening. The Trust has established this program in New York City, Boston, Metro Boston, Dallas, New Orleans, Los Angeles, Chattanooga and many more cities and will use this approach to implement it in Springfield. Through their approach, they will work in partnership with the city to apply science, GIS spatial decision support, research, and project design expertise to find neighborhoods and sites where multiple-benefits can be realized through a single strategic investment. The Climate-Smart Cities(tm) work also focuses on social equity or "climate justice". They apply social, demographic, and health analyses as an overlay to their framework and ensure that vulnerable populations are prioritized for green infrastructure investments and policies. They can use their spatial data to understand which urban neighborhoods have a high level of seniors, a strong urban heat island, and low urban tree canopy which can help prioritize "cool"-related green infrastructure efforts since seniors are much more likely to suffer health impacts during summer heat waves.

The Trust has earned multiple awards for its innovative use of GIS mapping technology. For Springfield, the Climate Smart Cities GIS team will include Breece Robertson, GIS Director, Chris David, Project Manager, and Lara Miller, GIS Analyst. Holly Elwell, Climate Smart Cities national Program Manager and Darci Schofield, MA/RI Urban Program Director will lead the field program implementation with support from local and national leadership staff Jad Daley, Climate Conservation Director, Shaun O'Rourke, Green Infrastructure Director, and Kevin Essington, MA/RI Director and a project associate. The Trust for Public Land also has attorneys,

real estate experts, marketing, finance and philanthropy both locally and nationally that will provide the necessary support to the program.

Reference: Carl Spector, Director of Climate and Environmental Planning, City of Boston, Environment, Energy, and Open Space, 1 City Hall Square, Room #709, Boston, MA 02201; carl.spector@boston.gov.

University of Massachusetts (UMass): at Amherst and Boston provide expertise in scientific research, engineering, fisheries/wildlife, planning, natural systems, water, infrastructure, urban planning and design, public policy, coastal and ocean sciences, data collection and analysis, computer modeling, downscaling of global climate change modeling data, development of scientific information and tools, and includes at UMass Amherst: the Massachusetts State Geologist; Departments of Geosciences, Environmental Conservation, and Civil and Environmental Engineering; MA Water Resources Research Center, and the federally supported Northeast Climate Science Center (NECSC); and at UMass Boston: the School for the Environment and several associated research facilities. At UMass Amherst, of particular relevance for work proposed in this application are the Department of Civil & Environmental Engineering, College of Engineering (COE); Departments of Environmental Conservation and Geosciences, College of Natural Sciences (CNS); the Massachusetts Water Resources Research Center, Office of the State Geologist, UMass Extension, and the Climate System Research Center, all under the College of Natural Sciences (CNS). In addition, UMass Amherst is the host of the federally funded Northeast Climate Science Center (NECSC), with faculty involvement from departments across CNS and COE. Research administration and support services are centrally managed under the office of the Vice Chancellor for Research and Engagement, including grants, contracts, and accounting.

Examples of Recent Work: A team of researchers at the UMass Amherst and MassDOT are developing a proactive and portable approach for evaluating flood vulnerability of certain road-stream crossings in the Deerfield River Watershed, plus a program for prioritizing future upgrades that accounts for climate change; it will supply a decision support tool to help prioritize upgrade and/or replacement options in the watershed at two time points: between 2040 and 2070 and again at the end of the century.

References: Paula L. Sturdevant Rees, Blaisdell House, 113 Grinnell Way, University of Massachusetts, Amherst, MA 01003, 413.545.5528, rees@umass.edu

The Massachusetts Geological Survey (MGS <http://mgs.geo.umass.edu/>) housed at UMass Amherst is the primary source of geological information and services for any activity that involves disturbances or activities on the landscape and it conducts research on the land, mineral, and water resources of the Commonwealth, and educates the public, government and industry on issues related to the geology, hydrology and natural history of the environment in which they live including the consequences of foreseeable natural hazards. MGS recently completed a [slope stability map](#) of Massachusetts that shows the location of potential landslide hazards in the Commonwealth with funding from FEMA. MGS also developed fluvial erosion hazard maps for four streams in the Deerfield River watershed and will develop additional maps for other streams within the Deerfield as part of this proposal. All of these projects, require project management, financial management and accounting as well as collaboration and execution of subcontracts or cooperative agreements with other agencies. Steve Mabey, the State Geologist, will be the principal manager of the Fluvial Erosion Hazard maps project in this proposal; Joe Kopera, assistant manager and associate state geologist, has expertise in Geographic Information Systems (GIS) and Nick Venti, a post-doctoral fellow, will oversee day to day operations of the project

and will work closely with a geomorphologist (to be hired contingent on award of funds) to conduct stream power analysis and fluvial geomorphological assessments for this mapping effort.

Springfield: The City of Springfield has extensive experience in management of federal grants, including Community Development Block Grant (CDBG), HOME Investment Partnerships Program, Neighborhood Stabilization Program (NSP), Continuum of Care Program, and Economic Development Administration (EDA) grants. Springfield planned and is implementing \$21.8 million in CDBG-DR projects, following the devastating 2011 tornado Springfield coordinated the CDBG-DR expenditures with the \$233.9 million in school building development fund for repairs due to the disaster and the \$134 million for rebuilding and alternate projects funded through Federal Emergency Management Agency (FEMA) public assistance.

Springfield has managed its recovery through an inter-departmental team led by the City's Chief Development Officer, closely coordinated with the City's Chief Financial Officer and City Solicitor, all reporting directly to the Mayor. The City established an Office of Disaster Recovery and Compliance ("DR Office") and hired the office's director, financial analyst, and DR program manager to administer the CDBG-DR program. The DR Office monitors the work through review of subrecipient policies and procedures, contract compliance, on-site monitoring visits, careful review of submitted invoices and backup documentation, and tracking of project timelines and outcomes. The DR Office provides technical assistance to subrecipients as needed. The DR Office is carrying out the homeowner repair program. The DR Office also reviews all bids, contracts, invoices and outcomes for compliance. The Department of Public Works (DPW) is overseeing design, engineering and construction for two major roadway realignment projects,

and design and engineering for a third roadway project intended to be constructed with state funds; the Department of Parks, Buildings and Recreation Management has overseen park restoration design and construction; and the Office of Management and Budget, with assistance from the Law Department, has negotiated and completed purchase of two school buildings. All these department will help with the Springfield projects.

The South End Revitalization Initiative that began in 2008 is a good example of Springfield's recovery management and multi-stakeholder involvement experience. The Initiative incorporates total public and private investment of over \$100 million and involves the coordination of private development, contractors, funders, sub-recipients, community stakeholders, and other government agencies in revitalization of this economically distressed neighborhood. Completed improvements include environmental cleanup, infrastructure redevelopment, demolition of blighted structures, urban renewal, park expansion and redevelopment, and development of single family homes.

Reference:

The Springfield Water and Sewer Commission (Commission): is a regional water and sewer utility providing water and sewer services to a population of more than 250,000. The Commission has extensive experience with the management of water supply and wastewater treatment capital projects and operations and maintenance. They are organized into functional administrative and operations management teams for water and sewer activities with a common engineering, finance, and procurement departments. The Commission has more than 20 dedicated engineering and operations staff, participates in the State Revolving Fund program and is familiar with all aspects of compliance related to the workforce, procurement, and construction

activities. The Commission has a Chief Procurement Officer and an Assistant Procurement Officer dedicated to compliance with local, state, and federal policies and procedures. It has an aggressive Capital Investment Program for the renewal of its infrastructure and has successfully completed more than \$45 million worth of water and sewer projects in the past four years. These projects have all been coordinated with the City of Springfield to minimize disruption, gain efficiencies, and develop the most cost effective approach to large scale construction programs. The Commission regularly participates in community and neighborhood council meeting to educate customers about our various construction programs and other pertinent information. Some recent multi-million dollar projects include, the Washburn Street CSO project (\$20m), the Main Interceptor rehabilitation project (\$23m), the South Transmission Main project (\$24m), a CSO project (\$18m), and their Integrated Wastewater Plan (\$8.7m).

Reference: Chris Curtis, Chief Planner, PVPC, 60 Congress St, Springfield, MA 01104, tel: 413-781-6045, email: chcurtis@PVPC.ORG.

Charlemont: The Town and the Sewer District: The Town of Charlemont has a population of 1,266 people and an annual budget of \$3M. One of its major economic drivers is outdoor recreation. The town's ability to implement economic revitalization hinges on a strong partnership with the Charlemont's Sewer District. The town has managed projects such as building of the Mountain Road Bridge, energy upgrades in their Town Hall, roof replacement in the Town Hall, and several smaller FEMA projects completed immediately after Tropical Storm Irene. The Town recently hired their first Town Manager with expertise in managing FEMA grant-funded projects, general administrative capacity, technical capacity for community engagement and inclusiveness.

The Charlemont Sewer District has a new Operator who is an engineer with strong technical expertise. He previously served at MassDEP for the Wastewater Program where he coordinated cross-disciplinary collaboration; collaborated with environmental stakeholders, planning agencies, and municipalities; negotiated with communities developing CSO projects, reviewed and commented on CSO Scope of Work projects for cities and towns such as Springfield, Holyoke, Chicopee, Palmer, Ludlow, and South Hadley ranging from \$10M to \$500M.

Reference: Nathan M. Seifert, Project Engineer, Project Manager, Weston and Sampson, Phone: 508-698-3034 ext. 7128, SeifertN@wseinc.com.

Williamstown: The Town has experience in rehabilitating residents displaced by severe events. It recently partnered with MEMA, FEMA and Morgan Management on a Hazard Mitigation Grant to manage, close, and remediate the Spruces Mobile Home Park which was damaged in 2011's Tropical Storm Irene, giving the town extensive experience in managing the financial logistics associated with the grant, managing hazardous waste disposal and general cleanup of a site, relocating residents and working with specialized relocation agents and social service agencies on this task as well as working with a grass roots citizen's committee on planning for the future of the Spruces as protected open space and parkland. The project included extensive public outreach and coordination between Public Works, Community Development, and the Town Manager's Office to ensure all residents are compensated, relocated, mobile homes are removed, the site is remediated and all applicable laws are complied with.

The Town hired a relocation consultant on this project, hazardous material abatement firms and procurement is ongoing for demolition services. Town Counsel and the Town Manager have successfully managed this process through a complex agreement with the Mass Attorney

General's Office, Morgan Management, and MEMA. The Town Treasurer and town staff have actively supported this project. Regular meetings are held with a grassroots citizen's committee to plan the future of the Spruces property, and with MEMA to track progress and coordinate goals. The Williamstown housing project will be supported by the Town Manager who is the Chief Executive and Chief Financial Officer of the Town. All personnel and financial decisions are the Manager's responsibility. The Town Manager delegates responsibility to five department heads and their respective departments, Community Development, Finance, Library, Police, and Public Works.

Reference:

Shellburne Falls Fire District: (SFFD) is a municipal provider of safe drinking water and fire services for the town of Shelburne Falls, a community of 2200 residents. The employees of the SFFD are trained as first responders to public emergencies such as fire, public water supply disruptions and natural disasters that threaten a continued supply of potable water for drinking and fire suppression. The SFFD is an experienced provider of project management, logistics, procurement and contract management of several large infrastructure projects including, but not limited to: the installation of 2 large capacity wells to replace a gravity fed reservoir; a new fire station and water department in 2005; several miles of water distribution line replacement throughout Shelburne Falls, and; two new 500,000 gallon storage tanks.

The SFFD, in tandem with many engineering firms, has assisted in the design and management of several large infrastructure projects. The SFFD has utilized architects to design and build the Shelburne Falls Fire District Fire Station and Water Department. The SFFD engages in cross-disciplinary collaboration with its fire service coordinators, emergency response

teams, municipal departments of public works and municipal government employees. It also collaborates regionally with the three towns of Buckland, Shelburne and Colrain; each with separate governing charters and municipal officials. The Shelburne Falls Fire District Water Department (SFFDWD) collaborated with several federal and state agencies, utility providers and community stakeholders prior to, during and after the flood event caused by Tropical Storm Irene. These collaborations included the MassDEP, MEMA, FEMA, the Federal National Guard, local Emergency Management Directors, utility providers, local contractors and the customers who rely on the public water supply for Shelburne Falls. The SFFDWD completed and implemented an Emergency Management Plan for Natural and Technical Disasters prior to the Tropical Storm Irene flood event in tandem with MassDEP. This planning contained emergency action protocols such as public notification, primacy notification and on site collaboration with MassDEP officials to ensure that the public received safe drinking water during the period when the wells were offline after being flooded by Tropical Storm Irene.

Management Structure: The SFFD employs a full time office manager and an elected Board of Commissioners to oversee the complex financial management of an organization that provides emergency services and water utilities. The SFFD management is comprised of three Commissioners who appoint the Fire Chief, Ambulance Director, Water Superintendent and Administrative Assistant.

Greenfield: The Town of Greenfield and its Department of Public Works provides municipal services to approximately 18,000 residents, including water, sewer, Municipal Solid Waste (MSW) disposal, recycling, and highway department, parks, cemeteries, engineering and emergency response. During the last several years the town has been a provider of project

management, procurement, logistics, and construction management for multiple capital projects. Their projects range from water, drain, and sewers main replacement to building a new \$72m high school. They have also been engaged in repairing a lot of infrastructure damage from the Tropical Storm Irene. Most of the department's 62 employees are trained as first responders. 24 employees are directly engaged in Water and Sewer operations and 8 are highway employees. The Greenfield-related projects in this proposal will be supported by their Director of Public Works who is an engineer, with experience in the Persian Gulf as an army officer specializing in water system management. He has over 20 years of experience in capital projects that include two water treatment plants, one sewer treatment plant, 9 bridge replacements, and multiple sewer, drain, and water main projects. The town's engineering department consists of a Town Engineer, Project Manager, and two Engineering Technicians; it also employs several engineering firms for technical support, two of which are engaged in designing the Fix-it-First projects in this proposal - Nash's Mill Bridge and the Maple Brook Culvert project. The town operates on a \$46 million dollar budget and the DPW operating budget \$6.7 million dollars.

Reference: Linda Dunlavy, Executive Director, Franklin Regional Council of Governments, 12 Olive Street #2, Greenfield, MA 01301, phone: 413-774-3167.

ReGreen Springfield (ReGreen): is non--profit organization, established following the 2011 tornado to provide assistance to the Springfield Department of Parks & Recreation and the Urban Forestry personnel with public outreach, recovery education and the planting of new trees. Regreen was integral in the replanting of over 3,000 trees throughout the tornado zone. Significant portions of these trees were planted as setback trees that involved a consultation process unique to private residential parcels. This was a national model that received widespread

international recognition. Regreen has worked with the USFS, USFWS, DCR, DOER, UMass Amherst and the City of Springfield on projects involving outreach, education, citizen science, research, tree planning, micro--climate monitoring and urban forest structure, function and value. Regreen is also partnering with TD Bank, Berkshire Bank, Smith & Wesson, and other local businesses and organizations to carry out tree planting and educational programming serving a variety of city residents, including at--risk youth and low--income residents. Regreen is working with the C--3 Community Policing Initiative in the South End, and has launched the 'Parks and People' educational program, which involves providing workshops and hands on environmental education learning to residents of the South End. Regreen consists of board members from the U.S. Forest Service, DCR, UMass Amherst, the Springfield Department of Parks, Buildings, & Recreation, the Springfield School Department, the Massachusetts Tree Wardens and Foresters Association, Massachusetts Certified Arborists, International Society of Arboriculture Certified Arborists and Board Certified Arborist Members. It is a key partner in our tree planting project in Springfield.

Reference:

Metropolitan Area Planning Commission (MAPC): MAPC is the regional planning agency for the 101 cities and towns in Metropolitan Boston. With a staff of 80, MAPC works from a variety of perspectives on resiliency and economic development projects. Departments engaged in this work include data and research, transportation, land use, environment, clean energy, public health, community engagement, economic development, homeland security, government affairs, procurement, strategic initiatives, and municipal collaboration. MAPC works on a variety of scales including site, municipal, regional, and state and with a variety of partners from

nonprofits and community-based organization to state agencies. We currently are engaged in over 150 projects and many are focused on resiliency (economic, environmental, and social) and a number of district, municipal, and regional economic development plans. Our projects include municipal and subregional climate adaptation projects that focus on vulnerable populations and vulnerability analyses, distributed energy projects, site-specific land use and transit-oriented development work, post-disaster business continuity and disaster preparedness, and work with the homeland security advisory council on equipment needs to support citizens during disaster recovery efforts.

MAPC's management structure includes our Officers, Executive Committee, our full Council, executive director, department directors, and program staff. We have an annual operating budget of \$6 million, coming from a variety of sources including state and federal funds, local contracts, private foundations, and an assessment from our member municipalities. We have experience with large federal grants and programs, including the highly successful HUD Sustainable Communities Initiative, in which MAPC was the convener of the MetroBoston Consortium for Sustainable Communities. During this four-year, \$4 million grant, MAPC worked with 160 Consortium members on a diversity of projects that advanced equity and sustainability across our region. We have developed a strong, internal project evaluation program and regularly monitor our work and the progress in our region against the goals of our long-term regional plan, MetroFuture.

Reference: Thomas G. Ambrosino, City Manager, Chelsea City Hall, 500 Broadway, Room #302, Chelsea, MA 02150, v: 617-466-4100, TAmbrosino@chelseama.gov.

The U.S. Endowment for Forestry and Communities (Endowment): is providing direct leverage for the Mohawk Trail nanotechnology project. It is a not-for-profit public charity that works collaboratively with public and private partners to advance systemic and sustainable change for the health and vitality of the nation's working forests and forest-reliant communities. It has a number of major partnerships with the USDA Forest Service to address forest health challenges at heightened risk of catastrophic wildfire. Current emphasis is market-based looking at advancing commercialization of low-value woody biomass as a renewable energy product to provide an economic driver to support forest health and restoration activity, advancing commercialization of low-value woody biomass as a high-value product via nanotechnology, and tapping biotechnology to provide new tools to address forest pests and diseases that are threatening rural and urban trees. The Endowment manages a diverse portfolio of initiatives, programs and projects representing in excess of \$5-10 million annually. The Endowment has vast experience in community engagement through their Sustainable Forestry and African-American Land Retention Program with the USDA Forest Service and NRCS.

Management Structure: The Endowment serves as convener and recruiter of team members and organizations necessary to advance solutions for a specific need. It operates with a lean staff model of just 7 fulltime employees. The four senior program/administrative officers each have extensive experience in forest management, conservation stewardship and/or rural economic development. They augment this team with a wide-range of independent consultants as needed.

Reference: 1. USDA Forest Service, Deputy Chief for State & Private Forestry Jim Hubbard (202) 205-1657, jehubbard@fs.fed.us.

Exhibit D – Need

Commonwealth of Massachusetts

Ph2ExhibitDNeedMA.pdf

Exhibit D - Need

Phase 2 Factor 2: Need/Extent of the Problem

Target Geography

Massachusetts Target Area. All of Massachusetts (MA) is considered a Target Area for resiliency planning under this application. Statewide, each county was impacted by two to five of the six federally declared disasters that occurred in MA between 2011 and 2013. These disasters resulted in over \$280 million in damages (MEMA letter to Obama requesting disaster declaration for 2015 snowstorms). While most of MA's unmet recovery need from these disasters remains in the western region of the state, all of MA, including Boston and the coastline, needs to prepare for the effects of climate change and become more resilient. MA is devoting significant resources to enhancing the resilience along the coastline and throughout the state (see Exhibit F).

MID-URN Target Areas. Target Areas for HUD funding (see Exhibit B) are: the Deerfield River Subwatershed, which comprises the contiguous area of the communities of Rowe-Monroe-Hawley-Heath-Charlemont-Buckland-Shelburne-Colrain-Greenfield in Franklin County; the town of Williamstown in Berkshire County; and the city of Springfield in Hampden County (Attachment E: Figures B-__ and B-__) which were affected by three, four and five of the qualifying disasters, respectively. Disasters causing most damage to housing, the environment and permanent public infrastructure were the tornadoes of June 1, 2011 and Hurricane Irene of August 27-29, 2011. Other qualifying events under the NDRC included Superstorm Nemo and unnamed snowstorms. Through phone calls and meetings since development of the Phase 1 application, the MA Team has been in close contact with affected stakeholders, communities and

their regional planning agencies, working with them to find sufficient documentation of more extensive unmet recovery needs.

The Deerfield River Subwatershed Target Area was created by expanding and combining the Phase 1 approved Target Areas of Charlemont and the Buckland portion of Shelburne Falls, and adding the damage and unmet recovery needs of a damaged bridge and a damaged culvert/sewer system in the city of Greenfield. Also, because the previously demonstrated unmet recovery need at Trout Brook/Route in Charlemont straddles two census blocks, block were include in Phase 2. They are the Phase 1-qualified Charlemont Target Area (Census Block #0110401001), which also includes Rowe and Monroe, and Census Block #0110401004, which includes Hawley and remainder of Charlemont. The Phase 1-qualified unmet recovery need to the Buckland side of Shelburne Falls was due to extensive bank erosion in the vicinity of the Shelburne Falls Fire District's wells on the North River in Colrain, which threatened the water supply of all of Shelburne Falls, situated in both Buckland and Shelburne. This erosion also created an unmet recovery need related to environmental degradation in the North River, which runs between Census Blocks # 0110401002 and 0110401003, affecting Colrain and Heath. Unmet recovery need of housing in Williamstown was documented by Berkshire Regional Planning Commission staff during a windshield survey in August (see Exhibit B).

Unmet Recovery Need

Springfield Target Area

On June 1, 2011, 4 tornadoes cleared a 6-mile swath through Springfield mostly affecting five low income neighborhoods and resulted in a 5-day State of Emergency

(http://photos.masslive.com/masslivecom_photo_essays/2011/06/mapping_the_path_of_tornado)

[es.html](#); http://www.springfield-ma.gov/cos/fileadmin/reports/HMP_for_Public_Review_and_Comment.pdf). The tornados caused 3 fatalities, including one in Springfield. Hundreds of roofs were torn off of homes and commercial buildings and rental units for over 300 residents were lost. The impacts also included damage from uprooted trees and debris, and theft of personal property. The Brookings Elementary School, Dryden Elementary School, and Cathedral High School, all in Springfield, were closed due to heavy damage (MEMA disaster assistance request letter). The Springfield Fire Department received 15,070 emergency calls and responded to 15,953 emergencies. For several weeks following the tornadoes, the city's Office of Emergency Preparedness facilitated meetings between the City's leadership, local utility companies, the Pioneer Valley Red Cross, the Salvation Army and other critical businesses (http://www.springfield-ma.gov/cos/fileadmin/reports/HMP_for_Public_Review_and_Comment.pdf.)

The tornadoes de-vegetated a large swath of Springfield, and the snowstorms decimated additional vegetation. Almost 10,000 acres of woodlands were destroyed in the storm's path including 7,500 mature trees in Springfield (<http://treesatrisk.com/tornado-season-remembering-1953-and-2011/>). The City has estimated that 30% of its trees were lost during the tornadoes. In the East Forest Park area of Springfield, where street-side tree canopy cover was stripped to 1%, the U.S. Forest Service estimated that mean morning and afternoon temperatures increased between 1-2°C compared to an unaffected neighborhood with 44% canopy cover (<http://www.unri.org/wsb4713307301/wp-content/uploads/2011/07/tornado-climate-report-2-reduced-size.pdf>). There needs to be sufficient tree stock to accommodate for increased

stormwater runoff and flooding anticipated, to provide cooling with increased temperatures, and to reduce demand for heating and cooling under climate change (give citation).

Unmet recovery needs also include 255 residential structures and another 615 residential units that were damaged and condemned as a result of the tornadoes. Through the ReBuild Springfield planning process, the community identified a goal of developing a process for transforming vacant lots and structures into community assets. The devastating effects of the tornadoes compounded the years of urban sprawl and disinvestment, worsening the city's blighted areas. The city needs to minimize blight by encouraging infill development, expanding green space, building community gardens, merging lots together, selling land with a disposition to abutters, and providing residents and developers with meaningful redevelopment tools (<http://www.developspringfield.com/pdf/1-CITY%20FINAL-Reduced.pdf>).

Springfield's infrastructure was significantly affected by the tornadoes and by the October 29-30 2011 snowstorm. The city paid an estimated \$750,000 to repair roads, sidewalks and other public infrastructure including significant sections of roads and sidewalk damaged by uprooted trees (http://www.masslive.com/news/index.ssf/2011/07/springfield_to_hire_firm_to_repair_tornado-damaged_roads_and_sidewalks.html). Unmet recovery need includes damage to the Flood Control Drainage System on Riverside Road (\$5,950,000); damage to infrastructure from trees and debris from the October 29-30, 2011 snowstorm (\$425,975); and damage to Van Horn Dam and Watershops Pond and debris removal and drainage/culvert repairs (\$ 2,620,000) (Cignoli eng reports).

Deerfield River Subwatershed Target Area

As much as 10 inches of rain fell during Hurricane Irene, causing record flood stages (http://pubs.usgs.gov/ds/775/pdf/ds775_report_508.pdf) throughout the Connecticut River watershed, including its tributary, the Deerfield River, and in the Hoosic River watershed, a tributary of the Hudson River. Torrential rains from Hurricane Irene caused miles of impassable roads and culvert damage; damaged hundreds of buildings; uprooted trees and vegetation; and dislodged demolition debris, roadways, and bridges, washing them downstream. The rapidly rising flood waters inundated water and wastewater facilities and dislodged propane and gasoline tanks, contaminating properties, homes and the rivers. Trees and power lines were lost, resulting in a loss of power to over 70% of all residents. (See photos from Bob Dean.) Effects of the hurricane stretched from Canada, through VT, NH, MA and CT. Statewide, 670,000 utility customers lost power. The storm caused over 100 injuries in MA and the death of a public works employee who was electrocuted by downed power lines in Southbridge (<http://usatoday30.usatoday.com/weather/storms/hurricanes/story/2011-08-28/Irene-pounds-Rhode-Island-155000-without-power/50162892/1>, <http://boston.cbslocal.com/2011/08/29/southbridge-worker-electrocuted-becomes-irenes-1st-mass-victim/>). Nearly a week after Hurricane Irene drenched New England, the Connecticut River was spewing muddy sediment into Long Island Sound (<http://earthobservatory.nasa.gov/IOTD/view.php?id=52059>). Approximately 1.2 metric tons of sediment was discharged by the Deerfield River during Hurricane Irene, producing as much as 40% of the total sediment observed on the lower Connecticut River (<https://mgs.geo.umass.edu/biblio/landslides-tropical-storm-irene-deerfield-watershed-western-massachusetts>).

Four landslides of sediment, trees, rocks and debris along the Cold River within the Deerfield River watershed caused a 6-mile stretch of Route 2 from Charlemont to Florida to close for over 3 months, disrupting a major connector to the metro-Boston area. Charlemont also experienced damage to culverts and destabilization of the surrounding floodplain. High flows in the North River (tributary to the Deerfield River) scoured the banks, damaged the water supply wells of Shelburne Falls, and breached a privately-owned dam. Nearly two years, later, fallen trees were still threatening public infrastructure in Charlemont. A resident met with the Selectmen in 2013 to discuss Rice Brook and reported that since Hurricane Irene, a fallen tree has caused the brook to re-direct its course on his property, which abuts a Town-owned park and the Hawlemont Regional Elementary School. During the hurricane, flooding of Rice Brook contributed to flooding of the park and the school's boiler room. Although heavy rains that spring continued to change the brook's course, the resident was unable to obtain a Massachusetts Wetlands Protection Act permit to remove the tree to prevent further damage to private and public property (<http://www.charlemont-ma.us/sites/default/files/minutes/selmin062413.pdf>). While MassDOT repaired the culvert at Trout Brook in Charlemont immediately after Hurricane Irene, it was designed using rainfall frequencies from NOAA's Technical Paper-40, published in 1961 (http://www.nws.noaa.gov/oh/hdsc/PF_documents/TechnicalPaper_No40.pdf). NOAA's Atlas 14, Volume 10, a sorely needed update of this information, is expected to be released in October 2015 and will define the precipitation event having a 1% chance of occurring (100-year storm) as being 8 or more inches, compared to 6.5 inches in TP-40. Unmet recovery need to replace the culvert at Trout Brook with one that has been properly sized is \$1,167,000.

Riverine flooding caused erosion of riverbanks on the North River in Colrain near the water supply wells of the Shelburne Falls Fire District's wells) with excessive sediment washing over fields, roads, and into buildings. The banks of the North River, a tributary to the Deerfield River, need to be restored and strengthened. Hurricane Irene flooded the Fire District's wells and severely eroded the river bank and land around the wells, which were off-line for 7 days following the storm. Unmet recovery need to repair the banks of the North River is \$460,000. The damage has caused environmental degradation to the North River in Colrain and is threatening the water supply of Shelburne Falls which serves portions of Buckland, Shelburne and Colrain (DropBox/Exhibit B/Col-Buck-ShelFallsEnviro1.pdf). The wells are vulnerable to future flooding and will be a complete loss unless the river bank is stabilized and the well heads are raised. The water supply also needs to relocate and repair its electrical system, unmet recovery need is \$219,000.

Flooding from the Green River (tributary to the Deerfield) impacted the Colrain Street Bridge area and damaged the Green River Dam, the Leyden Glen Dam, the Eunice Williams Covered Bridge, and Eunice Williams Drive, and severed an 8" sewer line in Greenfield (http://www.townofgreenfield.org/Pages/GreenfieldMA_Planning/HazMitPlan.PDF). Hundreds of residents were evacuated in Greenfield, including those in an assisted living facility. Houses and businesses were filled with mud and silt. The Greenfield Department of Public Works provided preliminary cost estimates for public works and infrastructure-related projects as of October 4, 2011 at \$12.5 million in response to damages from Hurricane Irene (http://www.townofgreenfield.org/Pages/GreenfieldMA_Planning/HazMitPlan.PDF). Damage occurred on Glen Road, an access route to the Town's water supply reservoir. Greenfield's

wastewater treatment plant, located at the confluence of the Green and Deerfield Rivers, was flooded with 18 feet of water. Costs for repairing the sewage plant exceeded \$650,000 (engineering report from Don Oullette). Hurricane Irene caused the Maple Brook Drainage Culvert in Greenfield to heave upward, disturbing drainage and sewer lines. Since then, infiltration and inflow into the sanitary sewer system have increased to 5 to 8 million gal/day, and there is surcharging of sewer and drainage manholes at various locations across the town. During heavy rain, untreated wastewater discharges directly to the Green River through a flow regulating chamber overflow. The city has hired an engineer to design a new sewer main to run outside of the drain line. The estimated cost is \$2,000,000 (reference AECOM letter report and Don Oullette report); Greenfield does not have funds available for the work. Repairs are needed to prevent sanitary sewer overflows of the sewer system and discharge of raw wastewater to Green Brook through the culvert. Also in Greenfield, Hurricane Irene compromised the Nash's Mill Bridge by scouring and moving the bridge abutments. After the storm, the bridge was deemed unsafe for normal traffic. Currently, it is restricted to one lane and has a weight limit of 12 tons; fire trucks and buses are prohibited from use, causing a significant safety concern for the fire department and increased transportation costs for the school department. The bridge should be elevated and the abutments moved out of the river. The project was recently added to the State DOT's project list, however, funding will not be available for 8 to 10 years so unmet recovery need is \$3,000,000 for construction costs. Total unmet recovery need in the Deerfield River Subwatershed is \$6,846,000.

Williamstown Target Area

In Williamstown, 191 homes at the Spruces Mobile Home Park were damaged or destroyed by flood waters along the Hoosic River, rendering them permanently uninhabitable and displacing

270 residents. This mobile park was a 55 years and older community for low income families, most of whom did not have insurance on their homes. At a December 2013 special town meeting in Williamstown, residents overwhelmingly voted to take ownership of the park and place a conservation restriction on the 116-acre parcel. The Selectmen signed a notice of discontinuance stating the flood-prone Spruces Mobile Home Park will close as of Feb. 29, 2016. The town hired a Relocation Agent to help residents find new housing; spending least 10 hours with each household to assess their cases (http://www.berkshireagle.com/news/ci_25248221/closing-date-williamstown-s-spruces-mobile-home). The newly constructed Highland Woods will be a 40-unit community of one- and two-bedroom apartments ready for occupancy in early 2016. This housing will be available to those with incomes up to 60% of Area Medium Income. This is a start, but there still remains considerable unmet recovery need for affordable housing in Williamstown.

Resilience Needs Within Recovery Needs

Resilience Example #1. Greenfield Water Pollution Control Plant, which was severely flooded during Hurricane Irene, flood-proofed its facility to protect against floods at the 100-year flood elevation. The town invested \$650,823.06 to remove all equipment from the basement to the first floor and installed two flood protection doors to give the facility an elevation of 144.3 feet; the doors cost \$107,246. These measures protect wastewater treatment services for the 17,456 residents of the city. Had they been implemented before Hurricane Irene, the plant would have avoided \$650,000 in damages and the resiliency measures would have paid for themselves (reference engineering report and email)

Resiliency Example #2. Damage from Hurricane Irene to a 6-mile stretch of Route 2 from Florida (outside of the Target Area) to Charlemont included debris flows, four landslides, fluvial

erosion, and undercutting of infrastructure, costing \$23,911,342 in repairs (See DOT spreadsheet). In 2013, MA State Geologist, Steve Mabee, developed a series of slope stability maps (including one that includes the Deerfield River Subwatershed Target Area) and an accompanying report using a protocol developed by the North Carolina Geological Survey (see Steve Mabee map and report). According to his report, landslides in MA occur with regular frequency and result in costs to MassDOT of \$1,000,000 for cleanup and \$2,000,000 for preventative measures. The maps show the locations of potential landslide hazards in MA and provide the public, local government and local and state emergency management agencies with locations of areas where slope movements have occurred or may possibly occur in the future under the right conditions of prolonged antecedent moisture and high-intensity rainfall. This information will be useful to MassDOT and local highway departments as they plan upgrades and improvements to infrastructure and facilities that may be at risk. The cost to develop the maps and study was \$64,261; if these tools are used to identify priority areas for protection and improvement, MassDOT will likely avoid losses considerably higher than this each year.

Resiliency Example #3. During Superstorm Nemo in February, 2013, the MBTA made the pre-emptive decision to shut-down services for 48 hours. The MBTA also shut down its services between January 26-28, 2015 during severe winter weather, and then provided partial service as it removed snow and made repairs to frozen lines. Service was not fully restored until February 22, 2015. Economic losses due to disruption in transit service were estimated by IHS Global Insight to be \$265M for each 24 hour period of lost service. (See Section 7 and Appendix 3: <http://www.mass.gov/governor/docs/news/attachment-a-severe-winter-weather-pattern-impacts-supplemental-info.pdf>). In June 2015, Governor Baker announced an \$83.7M MBTA Winter Resilience Plan to add snow blowers and plows, upgrade third rail heaters, and acquire de-icing

fluids. Planned updates could have prevented the entire outdoor portions of the third rail on the Red and Orange lines from freezing had they been implemented last year

(http://mbta.com/about_the_mbt/news_events/?id=6442454500&month=&year;

<https://www.bostonglobe.com/metro/2015/09/23/governor-baker-reviews-mbta-plans-for-winter/TXBMVrM9bTM5Jc4R3lFWyM/story.html>). This resiliency plan should help avoid

shutting down the MBTA and avoid the loss of hundreds of millions of dollars during the next serious winter storm.

Estimate of Necessary Investment in Resilience. It is daunting to consider what might be cost-effectiveness investment in resilience might be to appropriately benefit the Commonwealth. The Commonwealth's largest infrastructure projects – the Boston Harbor cleanup and the Central Artery/Third Harbor Tunnel transportation project – cost \$6 billion and \$22 billion, respectively. However, the MA Team is confident that the costs would be well-justified when comparing them potential losses due to disasters under climate change. Even under current climatic conditions, impacts from extreme events are costly. In addition to impacts detailed in this application, flooding of the MBTA subway system in Boston in 1996 resulted in more than \$92 million in damages (DropBox/Exhibit D/Ruth et al 2007.pdf). Combined with impacts from climate change (Melillo et al, 2014 at <http://nca2014.globalchange.gov/report/regions/northeast>), costs to recover from extreme events could be prohibitively high. The average annual cost of climate change impacts to the U.S. could reach 2.6% of the gross domestic product by 2100 (DropBox/Exhibit D/Ackerman et al 2009.pdf).

MA's 1,500 miles of coastline faces a substantial rate of sea level rise and erosion, and is naturally subsiding. Our region is identified as the "Northeast Hotspot" (DropBox/Exhibit D/Sallenger et al 2012.pdf). In the past 40-60 years, sea level rose 3-4

times faster than it did globally and relative sea level in MA rose 9" from 1921 to 2006 and this trend is predicted to continue at an increasing rate. Sea level in MA rise could be 6.6' by 2100 (DropBox/ Exhibit D/Sallenger et al 2012.pdf) as sea surface temperatures are predicted to increase 8°F and coastal areas are expected to experience greater storm surges. Superimposing storm surges onto increased sea levels further increases vulnerability of low-lying coastal areas, subjecting them to extensive flood damage. Boston is predicted to have the 4th highest risk to asset exposure due to sea level rise. Asset exposure from a mid-century 100-year storm event is estimated to exceed \$400 billion while current asset exposure to a 100-year storm is estimated at \$77 billion (DropBox/Exhibit D/Lenton et al 2009.pdf). With the dense population and development that exists along the coastline, and the prevalence of antiquated infrastructure, impacts from climate change will only be compounded without efforts to fortify, buffer or move structures to less vulnerable areas. Evacuation costs in MA from sea level rise and coastal surge could range between \$2 billion and \$6.5 billion, depending on the severity of the storm event (Ruth et al 2007.pdf). These impacts and other climate change effects such as increased temperature will pose a challenge to MA and will place a disproportionate burden on vulnerable populations including low- and moderate-income areas such as our target areas, elders living on fixed incomes, and workers who cannot access alternative housing or transportation during disasters. All of this places the cost of necessary investment into perspective since the cost of inaction will be far higher.

Vulnerable Populations and Factors Hindering Resilience. Springfield is a diverse city with people of color comprising 65% of the city's population of over 153,000, including 40.5% Hispanic or Latino, 19.2% Black or African American, 2.2% Asian and 2.0% two

or more races. 38.5% of the population over 5 years old speaks a language other than English. Median household income is \$34,311 and 29.4% of the population lives below the poverty level. 64.1% of children under 18 years old live in households with Supplemental Security Income, cash public assistance income, or Food Stamp/SNAP benefits (<http://factfinder.census.gov>).

Of those 25 years and older, 31.3% of the population has graduated from high school and 10.7% has earned a bachelor's degree (<http://factfinder.census.gov>). The Commonwealth has designated Springfield one of 26 "Gateway Cities," defined as having median household incomes below the state average, populations greater than 35,000 and less than 250,000, and rates of educational attainment of a bachelor's degree (or higher) that are below the state average. The City of Springfield was awarded \$21.8 Million Community Development Block Grant Disaster Relief funds for disaster related relief, long-term recovery, restoration of infrastructure and housing and economic revitalization as a result of federally declared disasters in 2011 and 2012.

The Deerfield River Subwatershed Target Area is predominantly white with modest salaries and elevated rates of poverty (\$49,760 and 9.4%, respectively, in Buckland; \$50,329 and 12.1% in Charlemont; \$50,833 and 10.1% in Colrain, \$48,230 and 15.4% in Greenfield, \$63,750 and 13.6% in Hawley, \$53,750 and 9.8% in Heath, \$36,875 and 11.1% in Monroe, \$53,750 and 15.9% in Rowe, and \$55,500 and 7.3% in Shelburne). Greenfield's population of 17,526 is 67% of the Target Area's population. The other towns have populations between 117 and 2093. (<http://factfinder.census.gov>). Districts of the Mohawk Trail Regional School System, serving Target Area communities Buckland, Charlemont, Colrain, Hawley, Heath, Rowe and Shelburne, "have a high rate

of mobility for both foster children and families who struggle with housing”
(<http://colrain-ma.gov/documents/TownReports/Colrain2013AnnualReport.pdf>).

The largest employers in Charlemont are the whitewater rafting industry, the Charlemont Inn, and the Hawlemont Elementary School. State aid is the second largest town revenue source, with commercial revenues accounting for less than 15% of the total revenue collected (<http://www.charlemont-ma.us/economic-development>). Charlemont has a very high share of mobile homes and trailers, making up 13% of the total housing units (<http://www.charlemont-ma.us/executive-summary>). Buckland is a predominately agricultural community. The Mohawk Trail Regional School System, serving several Target Area communities, including Buckland, Charlemont, Colrain, Hawley, Heath, Rowe and Shelburne, is a major employer in the area. Yankee Atomic Electric Company, public schools and municipal services are the largest employers in Rowe. The municipality is the largest employer in Monroe, Hawley and Heath (http://lmi2.detma.org/lmi/Top_employer_list.asp?gstfips=25&areatype=05&gCountyCode=000198). Construction and retail are also important employment industries. A Manufacturers Mayhew Steel and the Lamson & Goodnow Cutlery Manufacturing Company are also the larger employers (<http://town.buckland.ma.us/about-buckland/about-buckland.html>). In Greenfield, the largest industries are manufacturing, wholesale and retail trade, and health care. Williamstown has a population of 7,754, median income of \$71,612, and poverty rate of 6.6%. Employers include Williams College and businesses related to tourism. Although Williamstown is not a low and

moderate income community, 65.6% of the residents earn less than 80% of AMI in the census block where the Spruces Mobile Homes were located.

Throughout MA, poverty levels have increased steadily over the past few decades ([http://www.massbudget.org/report_window.php?loc=From%20Poverty%20to%20Oppor tunity.html](http://www.massbudget.org/report_window.php?loc=From%20Poverty%20to%20Oppor%20tunity.html)). 19% of the population in Hampden County, where Springfield is located, is below the poverty level, as does 21% of Suffolk County, where Boston is located. 25 years ago, nearly 20% MA residents were poor or near poor (with incomes <200% of poverty level). Today, that statistic has increased to about 25%. The state's child poverty rate rose from 9% in 1970 to 16% in 2013. This nearly doubles if children who are near poor are counted. Children of color are at particular risk for economic vulnerability; almost half of Black children and two-thirds of Hispanic children are poor. About 20% of MA families are headed by a single female; those families with at least one child age 3 years old or younger are more likely to be in low wage jobs. MA residents are also burdened by high rent as a % of their household incomes; in Hampden County, 45% of renters pay 35% or more of their household incomes on rent. The tourist-dependent areas of MA, where property values are high and wage low, are even harder hit by high rents: in Dukes County, that figure is 47% and in Barnstable County (Cape Cod), that figure is a staggering 50%. There are areas of poverty and other circumstances that make it nearly impossible for the population to face the challenges of disaster recovery and climate change preparedness without assistance. With HUD funds to fill gaps, we will revitalize local economies, enhance protection of the built environment, and preserve and protect public health and safety. MA's resiliency plan would enable communities such as

Springfield to be robust, sustain thriving populations and businesses, and become more resilient to changing climatic conditions.

Appropriate approaches

Protect Against Riverine Flooding. A holistic, watershed approach is needed to manage higher river flows that result from increased precipitation and to ensure that the environment is protected against these increasing streamflows, and buildings and infrastructure are properly located and designed to avoid or withstand the impacts of these flows. During periods of high rainfall, the urbanization of Springfield, with its relatively high amounts of impervious cover, and the natural environment of Franklin and Berkshire Counties, with their steep hills and riverine systems, both cause stormwater to runoff quickly, resulting in extreme streamflows and poor water quality that are harmful to buildings and infrastructure, the environment, the economy, public safety. Widespread flooding (especially flash floods) can cause massive damage to roadways and wash out homes. The bridges and culverts of our Target Areas need to be re-sized for actual rainfall and resulting flows, not for rainfall taken from a paper published 54 years ago. Water and wastewater infrastructure needs to be inspected and retrofitted with flood-proofing strategies, if not moved altogether.

Control Stormwater Runoff and Non-Point Source Runoff Pollution. Stormwater runoff draining to a stormdrain system and non-point source runoff draining directly from open land such as farms into a receiving body can be laden with contaminants such as nutrients, sediments, bacteria, and pesticides. These contaminants pose threats to water quality, aquatic health, and human health. During extreme flooding events, stormwater or river water can wash pollutant from oil tanks and other features on the land into the river.

In Springfield approximately 20,865 acres of impervious cover (34% of the city) is directly connected to the stormwater system. Impervious cover, combined with the loss of trees, has increased runoff and flooding of roads and streams. Loss of groundwater infiltration and control of stormwater discharges need to be accomplished, in part, through installation of rain gardens, tree plantings, permeable pavement, and other green infrastructure and low impact development features

(<http://www.pvpc.org/sites/default/files/PVPC%20Green%20Infrastructure%20Plan%20FINAL%2002-18-14.pdf>).

Prevent Inundation of Wastewater Treatment Plants and Combined Sewer Overflows.

Springfield has a combined system of stormwater and wastewater collection, treatment and discharge. During peak rainfall, this system overflows, discharging a combination of stormwater and raw wastewater to receiving waters and creating a risk to water quality, aquatic health and human health. In addition, because wastewater treatment facilities are situated in the vicinity of the waterbodies that to which they discharge, they are susceptible to inundation by the river during large storms with high streamflows. This was the case at the Greenfield Water Pollution Control Facility.

Repair Damage to Buildings and Infrastructure. Strong tornado or hurricane winds and extreme streamflows are especially destructive to public infrastructure including roadways, municipal buildings, electrical structures and equipment, and wastewater facilities. Loss of services from affected infrastructure in Springfield and in the Deerfield River Subwatershed presents a hardship to communities who may have establish make-

shift schools or offices or detour roadways for many miles, as was the case along Route 2 in Charlemont.

Replace Loss of Trees and Repair Damage from Trees. Structural damage in Springfield and the Deerfield River Subwatershed occurred from trees during the disasters. Fallen trees or limbs can puncture roof-tops, land on cars, or collapse electrical wires. Between heavy winds and flooding, trees can be uprooted and carried long distances with relatively high velocities. Trees traveling in floodwaters can cause severe damage to infrastructure or be deposited on roadways once the water subsides. Springfield lost 7,500 mature trees (<http://treesatrisk.com/tornado-season-remembering-1953-and-2011/>) and spent an estimated \$750,000 to repair roads, sidewalks and other public infrastructure damaged by trees in the June 2011 tornadoes. The work ranged from repairing significant sections of roads and sidewalk damaged by uprooted trees to minor repairs along small sections of sidewalk. Another issue of downed trees is safety --- a public works employee in Southbridge, MA was electrocuted by downed power lines during Hurricane Irene. Damaged infrastructure and safety issues from fallen trees are common throughout the county, with Duke Energy commenting, “During severe weather, such as hurricanes, tornadoes or ice storms, trees may be uprooted and fall onto the power lines, knocking down miles of power lines and poles. In these instances, we have to completely rebuild the electrical line. This is dangerous and time consuming work and may cause you to be without power for longer periods of time....High winds or fallen trees may cause power lines to touch and short out, causing an outage. Wind may also blow tree limbs or entire trees onto the power lines, causing the lines to fall to the ground and possibly even break the lines and poles” <https://www.duke-energy.com/north-carolina/outages/causes.asp>.

Provide Uninterrupted Power and Heat. Heavy wind or rainfall can snap utility poles and detach power lines as were the cases in the Springfield and Deerfield River Subwatershed Target Areas. Substantial rainfall and flooding can wipe out electrical structures, damage above- and below-ground electrical equipment, or cause other debris to come in contact with the lines or electrical structures. Power outages occurred throughout the Target Areas and all of MA during the disasters. A year after Hurricane Irene, electric utility National Grid reflected on lessons learned from the storm and determined that it needed to control damage from fallen trees by "collaborating with local communities on aggressive tree trimming to help limit outages during future weather events." It was also reported that National Grid "enhanced management of wires down situations to free up local police and fire and has improved dispatching and tracking of outside crews to speed restoration" (<http://patch.com/massachusetts/attleboro/national-grid-says-lessons-learned-from-irene>).
<http://www.nbcconnecticut.com/weather/stories/All-Eyes-on-Irene-128351438.html>,
https://en.wikipedia.org/wiki/Hurricane_Irene#New_England_2).

Replace Lost Housing. Numerous factors can cause damage to homes or create the loss of housing. Fast-moving flood waters have the potential to pick up and displace entire structures, especially mobile homes like those that were wiped out at the 191 homes at the Spruces in Williamstown. Tornadoes in Springfield also caused significant damage to 255 residential structures and 615 residential units of housing. Even once the floodwaters or tornadoes subside, there are safety risks such as weakened, dislodged, or rotting structural supports, and molded or contaminated wood surfaces. Other factors associated with disasters, such as debris and sediment, can also damage homes.

Alleviate Economic Impacts. Economic losses due to a disaster include, but are not limited to, damage to buildings and infrastructure, agricultural losses, employment and business interruption, impacts on tourism, and loss of tax base. According to the state's Hazard Mitigation Plan, "Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and roadblocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges, and the removal and disposal of debris can also be an enormous cost during the recovery phase of a flood event. Direct building losses are the estimated costs to repair or replace the damage caused to the building. As discussed, the potential damage estimated to the state facilities associated with the 1-percent annual chance flood is greater than \$1.5 billion." (pp. 10-41 to 10-42, <http://www.mass.gov/eopss/docs/mema/mitigation/state-hazard-mitigation-plan/section-10-flood.pdf>).

Anticipate Effects of Climate Change. As presented in great detail in the MA Team's Phase 1 application, any resiliency strategy must also address the effects of climate change, which are expected to include increased temperatures, precipitation, droughts and sea level rise.

Statewide. MA communities are often supported by infrastructure more than 100 years old that is in need of repair and replacement and designed using outdated estimates of precipitation and flooding. Also, the natural landscape has been significantly modified. Development has increased impervious surfaces, increasing stormwater flooding and streamflows. Rivers have often been channelized, placed in culverts, and completely

disassociated from floodplains. This has compromised their structural integrity and fluvial geomorphology, and increased flooding even during smaller storm events. We need to restore rivers and floodplains, stabilize river banks, plant trees, and conserve open space and forests. We need to upgrade existing crumbling infrastructure and design replacements that can accommodate future changes in climatic conditions so that residents, businesses, and their communities will be protected. We need to ensure that power and heat supplies are available – without extended periods of interruption. As a society, MA and especially its vulnerable people need to take action to eliminate the devastation to environment and reduce the potential for damage to structures and infrastructure when natural hazards, such as those leading to the six federally declared disasters experienced in MA between 2011 and 2013 occur again.

Exhibit E – Soundness of Approach

Commonwealth of Massachusetts

Ph2ExhibitESoundAppMA.pdf

Exhibit E – Soundness of Approach

A. Introduction

The Commonwealth of Massachusetts experienced six federally declared national disasters between 2011 and 2013, which have highlighted the impacts of changing weather patterns on the state and its communities. Massachusetts (MA) is eager to expand its climate change resiliency and preparedness efforts in order to address damages from these disasters as well as increase resiliency for the future to minimize the potential for additional harm resulting from severe weather events. The MA Climate Adaptation Report provided a comprehensive overview of climate impacts to a broad spectrum of sectors within the Commonwealth and has been guiding decision making, regulatory changes, policy frameworks, project development and funding decisions since it was published in 2011. As we look to the future, we will build on past successes, increased scientific understanding, and lessons learned from these investments. We want to plan and manage impacts of climate change before they occur rather than only be reactive, after an impact takes place. Doing so reduces costs, minimizes or prevents impacts to public health and safety, minimizes damage to crucial natural resources and built infrastructure, and does not disproportionately impact vulnerable populations

We have evaluated resilience in the state on a watershed-by-watershed basis to identify the most vulnerable populations and community unmet needs that exist from past and future disasters. In Phase 1, we highlighted the need for robust science, data collection and analysis and tools for improved adaptation to climate change. Since the completion of the Phase 1 application, we have used an open and inclusive process that involved several meetings, numerous phone calls, and two public hearings over a two-month period. As a result of this extensive

collaborative process with stakeholders, we have identified the Connecticut River Valley watershed in western Massachusetts as the focal point for our Phase 2 program, which consists of a number of projects aimed at increasing resiliency in this watershed.

The Connecticut River Valley watershed region has been disproportionately affected by five of the six federally declared disasters occurring between 2011 and 2013. This region includes a large number of low and moderate income communities. Due to lack of resources combined with extreme effects of hurricanes, historic snowfalls, flooding, and tornadoes, many of the damages experienced in these communities have still not been rectified, leaving them even more susceptible to future disasters. Of the recent disasters, Tropical Storm Irene in August 2011 caused significant flood-related damage. The storm resulted in estimated economic damages of over \$34 million for individual residents and municipal infrastructure.¹ Damage to state infrastructure was much greater, with repairs to Route 2, the main lifeline in the Deerfield river watershed, alone reaching \$34 million. Our goal is to increase resilience both by addressing currently unmet needs as well as building in additional protections and redundancies in natural systems and built infrastructure to minimize the potential for such catastrophes to occur again at the same scale in the future.

Our projects in the Connecticut Valley represent a dual approach to climate preparedness - creating watershed resilience while also facilitating economic vitality in the region (Att E-Fig E-1). The Valley is one of the more economically depressed parts of the state, which has a particularly hard time bouncing back from disasters. This region reflects social dynamics such as

¹ PVPC Climate Action and Clean Energy Plan. Original citation: Massachusetts National Guard. Hurricane Irene Response. August 2011.
<http://states.ng.mil/sites/MA/PDF/Mass%20Guard%20Hurricane%20Irene%20Storyboard.pdf>.

wide rural-urban gradients, varied topography, socio-economic inequity at both the household and community levels, and a unique culture that balances a strong sense of community with a fierce love of independence. There exists a great need for strategies in this valley that simultaneously address the population's low socio-economic status and limited resilience to flood and other disaster-related impacts. Making this region resilient is a combination of fostering economic vitality while creating a stable landscape on which the settlements inhabit. Without economic revitalization, even with a stable riverine system the communities, especially vulnerable populations will not have the capability of recovering from an extreme event; and without a resilient watershed even an affluent area will face huge losses from real estate losses and devastation of public infrastructure from flooding and other climate impacts.

The CT River Valley watershed contains two distinct nodes of development: urban centers and rural/ semi-rural geographies, with little suburban development between these land uses. A map illustrating the target area communities in the western part of the state is provided as Figure E-1. Our proposed Phase 2 program includes projects targeting each of these land use nodes, and includes node-specific projects in the pilot areas, which could be expanded to additional similar types of land uses based on the results. In the rural/semi-rural areas, projects are focused on landscape improvements and forestry management, with relatively limited infrastructure improvements limited to key developed areas. In contrast, the urban node includes more impervious cover, higher population densities, and more complex infrastructure, such as larger wastewater treatment plants treating and discharging high flow volumes. Projects in the urban node are therefore more focused on increasing resiliency and the built environment, rather than focusing on natural landscapes. The Phase 2 projects proposed are described in detail in subsequent subsections of this narrative.

In addition to the two key nodes of focus for project implementation, a location-specific housing project is proposed in Williamstown, Massachusetts, in an area immediately adjacent to the CT River watershed. This project has been included because Tropical Storm Irene directly impacted and destroyed this LMI population housing. It is critical that the people that were displaced be provided alternative permanent housing that is more resilient to future disasters. In addition, implementation of the housing project will serve as a template for similar housing projects in the region and be replicated at other LMI housing units.

Implementation of the projects will assist us with accomplishing our long-term resiliency goals for the state, which were originally identified and investigated during Phase 1 of our program. The Phase 2 proposal reflects a continuity of project themes and builds on project ideas that were articulated in Phase 1, such as the Community Clean Energy Resiliency Program, which provides clean energy resilience grants to municipal/regional entities to harden critical energy services using clean energy technology. This program will be enhanced by the proposed Phase 2 “Reliable Energy for Low Income”, which is an Energy Justice program. Similarly, the Phase 2 Deerfield River Resiliency project includes a “Green by the Stream” program, which continues Massachusetts’ commitment to green infrastructure begun in Phase 1 with Coastal Resilience Grant Program.

Alternatives evaluation: Many alternative Target Areas were considered during this competition. Coastal areas, such as Oak Bluffs, were impacted by Hurricane Sandy and we considered projects such as seawall repair, beach nourishment; and elevation of buildings to protect against sea level rise and coastal surge. Despite the damage identified in Oak Bluffs, it was difficult to find enough other coastal communities that had sustained damage during the disasters. We found it difficult to develop a cohesive application that had both river resiliency and coastal resiliency

themes. We were strongly advised during the Rockefeller Foundation's Resilience Academy in Chicago to choose the Connecticut River watershed, where damage from disasters between 2011 and 2013 was greatest. We also considered Boston as a Target Area but were unable to identify unmet recovery need beyond a seawall that was damaged by Hurricane Sandy. Tie-back of projects that would have benefited the most vulnerable people of Boston would have been very difficult. The state also considered and dismissed the following:

No Action: While the costs of making changes and actively managing the built and natural environments to buffer the impacts of climate change may be substantial, the cost of inaction may be far higher. An increased frequency of rainfall (recently defined in NOAA's Atlas 14, Volume 10), with its new definition of the 100-year storm, has contributed to record-breaking streamflows over the past decade. Flooding damage can be significant. Using the coastline as an example, sea level rise of 0.65 meters (26 inches) in Boston by 2050 could damage assets worth an estimated \$463 billion (Lenton et al., 2009). Evacuation costs alone in the Northeast region resulting from sea level rise and storms during a single event could range between \$2 billion and \$6.5 billion (Ruth et al., 2007). If existing impacts from past extreme events are not addressed, then additional heavy precipitation and riverine flooding would wash out additional at-risk culverts, and roads, and flood more streets, houses, and infrastructure such as water and wastewater treatment plants. In particular, this path of no action would unfairly affect low income and other vulnerable groups of our society that have a particularly hard time of moving out of harm's way. Statewide Vulnerability Assessment and Adaptation Plan: Due to very constrained budgets the state could not commit all the funds that are required for this type of comprehensive assessment. However, many aspects of this analysis are already underway since September 17, 2014 such as, assessments on transportation infrastructure, culverts, dams,

biological resources, and public health impacts. Shared Bicycles in Springfield: While this was an excellent idea and would have provided many benefits to the community, it was difficult to demonstrate a tie-back of this project to the disasters in Springfield.

Project 1. Plant a Tree Project

Lead: EEA

Project Description: This project will significantly increase urban tree cover in low and moderate income neighborhoods by hiring and training local unemployed residents and significantly reducing the summer and winter energy bills by reducing winter winds and summer neighborhood temperatures for low income residents, especially renters. Trees also promote evapotranspiration and interception (trees hold hundreds of gallons of water in their canopy that evaporates instead of landing on pavement and lawns and becoming stormwater) of stormwater that would otherwise run off into local streams, uptake water pollution from stormwater such as nutrients and provide relief from the urban heat island effect. To take advantage of these multiple benefits, we are proposing a tree planting project throughout the state applying the Commonwealth's funds in Gateway Cities and more intensely focusing in our Target Area communities of Greenfield and Springfield using HUD funds. The program consists of two elements – greening urban neighborhoods through the planting of trees in public rights-of-way and on other public properties, and the installation of stormwater tree boxes.

i. **Tree planting in Communities:** The Greening the Gateway Cities Program (GGCP) is a statewide tree planting program focusing on Environmental Justice (EJ) neighborhoods that is based on research and on-the-ground tree and energy measurements in Worcester, MA and other northern climate cities. GGCP is a partnership between EEA, EEA agencies – DCR and DOER, and DHCD, Mass Development along with Gateway Cities and local grassroots organizations.

The program puts cities on a path of significantly expanding their tree canopy cover, creating local jobs and vocational training, and sustained municipal commitments to their urban forestry programs. Through the program, new trees are planted with a goal of covering 10% of the target neighborhoods in new tree canopy cover. The planting program is modeled after the USDA-funded program to remediate the damage caused to Worcester by the Asian Longhorn Beetle disaster in the winter of 2008/2009 when the tree canopy over a neighborhood of homes was largely removed. In Worcester it was measured that there was a dramatic 37% increase in summer energy use after this significant loss of canopy. Thus far more than 30,000 replacement trees have been planted. The relationship between tree canopy and reduction of stormwater runoff is widely accepted, and the co-benefit to overall neighborhood energy usage has been studied in other communities outside of Massachusetts, both warm and cold weather climates. In regard to protection against huge wind speeds of tornadoes and hurricanes, tree canopy brings the greatest benefits when established over an entire neighborhood area, lowering wind speeds and providing a co-benefit of reducing winter heating energy and summertime air temperature, in addition to the benefits of direct shading. It is estimated that every 1% increase in tree canopy above a minimum 10% canopy cover brings a 1.9% reduction in energy needs for cooling and up to a 1.1% reduction in energy for heating. Measurement of wind speed (a good proxy for heating energy demand by older, poorly-insulated houses) in Springfield after the tornados removed a swath of trees, indicated a 66% increase in winds (Morzuck, 2013). A USDA economic study found that tree planting returns a 2:1 economic multiplier (Hodges et. al., 2010) to the regional economy as tree planting is the only energy efficiency tool where all of the investments go into the local economy (trees are purchased from local nurseries, crews are hired locally, etc.). This program may exceed the USDA study estimate because it is a more labor-

intensive (less heavy equipment) approach. The tree planting investment is paid back 4 times via reduced energy bills paid by residents when trees are mature at 30 years and will continue for many years thereafter (Stantec, 2014).

Based on the energy savings, EEA and DOER have committed \$6.5 million. Over the past two years, 2,500 trees have been planted in Chelsea, Holyoke and Fall River with an expenditure of \$1.1 million. This fall, the cities of Revere and Chicopee have been added to the program. We are seeking HUD funding to further expand this program to Springfield and Greenfield with a focus on selected Environmental Justice neighborhoods with low tree canopy cover and old residences with little or no insulation to ensure that these areas will be protected against high winds. HUD funds would be used for public property right of way plantings, and other funds secured by EEA for plantings on private property (see attached map). For example, in Springfield 27% of the residents are below the poverty level, the average housing unit dates to 1949 and 68% of housing units are renter occupied. For Greenfield, 16% of the residents are below the poverty level, the average housing unit dates to 1939 and 49% of housing units are renter occupied. Traditional energy efficiency programs struggle to serve low income, renter neighborhoods because tenants pay for utilities and need landlord permission for projects. The GGC program is a unique way to reduce energy costs for low income residents and has fine-tuned a process where tenants request trees and agree to provide watering for two years and get sign-off from landlords for plantings.

The program has found that the most efficient method for planting is to use locally-hired crews and to hand-plant whenever possible to reduce capital equipment costs and benefit Environmental Justice communities particularly in Springfield where tornadoes destroyed approximately 7,500 trees. Trees are planted with an 11-person crew including 2 foresters who

supervise crews and conduct outreach meetings with the community, city officials, neighborhood associations and residents. This project will have two crews working in Springfield and part time in Greenfield to complete the project in 2-3 years. Trees are located with resident's input on private and public lands including within the 20 feet of the public right of way as authorized by the Massachusetts Public Shade Tree Law (General Law Chapter 87, Section 7). Planting is done during two twelve-week planting seasons during spring and fall. Crews are able to plant 50 trees per week from orders from residents based on outreach efforts. The resulting plantings will add 10% additional tree cover in the target neighborhood in 30 years when the trees mature in 8-10 years, the trees will cover 1% of the area and will have a measurable reduction in resident utility costs. This proposal adds a new partnership with the local non-profit Re-Green Springfield which has worked with EEA and the City to plant 1,100 trees in tornado affected neighborhoods via a federal Department of Energy grant in 2012. Re-Green completed outreach and worked with the community to fund an additional 400 trees with local funding in this project. Re-Green will help with local outreach and training of crews to help with future arboculture employment.

ii. **Stormwater Tree Box Filters:** This activity includes planting of trees with tree box filters in key locations to address stormwater runoff in Greenfield and Springfield and reduce combined sewer overflows in Springfield. In September 2015, PVPC (in partnership with the Cities of Springfield, Holyoke and Chicopee, Re-Green Springfield, Valley Opportunity Council, Nuestras Raices and the Conway School of Design) launched a \$240,000 U.S. Forest Service grant to design 9 streetscapes for tree planting and installation of stormwater tree filters. These designs will be utilized for the partnership with the City of Springfield's portion of the total 50 filters recommended for Springfield. The 25 tree filters in EEA's and Springfield's HUD

application will be focused in neighborhoods that the two applicants will be working most with the canopy planting portion of the project. The tree filter systems will have an immediate effect of reducing stormwater discharges and combined sewer overflows to these neighborhoods which are adjacent to the Connecticut River. The public trees are planted near paved areas so they also reduce pollutant loading during storms. A NYC study estimated each tree reduced stormwater by 1,525 gallons per year (Peper, McPherson, Simpson et al., 2007), and a recent EPA-funded study in Fall River (TetraTech, 2015), MA found that each tree filter is the equivalent of removing 1,000 square feet of pavement in stormwater flow and treatment reductions. The USDA grant includes the planning and design of about 25 tree boxes and the remaining designs for the other 25 tree boxes are proposed in this application. This project is a unique approach to helping low income residents of two cities by significantly reducing energy bills, creating jobs, reducing future Heat Island Effects, reducing stormwater pollution and flooding, improving air quality, enhancing local businesses and improving the overall quality of life in these neighborhoods.

Tie Back: Tree planting in targeted EJ neighborhoods will have a direct benefit in reducing runoff and stormwater damage from future storms and thereby increasing the resiliency of these impacted, low income communities. It will also mitigate for the losses that occurred in Greenfield and Springfield as a result of Tropical Storm Irene and the tornadoes, respectively. In addition, low income residents will receive the co-benefit from significant reductions in summer and winter energy costs.

Unmet Need/National Objective: This project directly meets unmet need in the city Springfield where the tornado ripped 7,500 trees from the ground and in Greenfield, which is located in the Deerfield River watershed, which was heavily impacted by Hurricane Irene. Additional trees in Greenfield will help with recharge, minimize erosion, and enhance resilience to future storm

events. The entire communities of Greenfield and Springfield are LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks and Resilience: Stormwater contributed significantly to the damage caused by Tropical Storm Irene to Greenfield and Springfield. As precipitation and the number of storms will increase with climate change, the increased stormwater mitigation from these projects will help reduce future flooding and related pollution- and erosion-related impacts and serve as a model for justification of installing more tree filter boxes throughout Springfield and Greenfield where urban neighborhoods drain to the Connecticut River. For example, each tree filter will reduce annual runoff by approximately 25,000 gallons (<http://cals.arizona.edu/cochise/waterwise/waterharvest.html>) and each tree filter will remove the following percentage of pollutants – TSS (82%), TPH (71%), TZn (93%) and TP (52%) (Houlem, James J., Puls, Timothy A., and Thomas P. Ballestero 2012 Performance Evaluation Report of the Portsmouth Tree Box Filter Treatment Unit, Univ. of NH Stormwater Center).

The trees and tree boxes will reduce stormwater flows within the downtown developed areas. The investment in public trees and tree filters will be returned in reduced stormwater and combined sewer overflow treatment costs (Deutsch B. et al., 2007). In addition, planting trees will reduce impacts to housing and infrastructure due to hurricanes and tornadoes. A co-benefit is that trees will save summer and winter energy costs, reduce the urban heat island effect which is being amplified by climate change, and reduce peak heat days and the associated health impacts for the elderly and vulnerable populations that live in these downtown neighborhoods. The number of days above 90 degrees is projected to increase significantly in future decades and will have an inordinate impact on low income residents of these downtown areas. Tree planting will also increase the resilience of the urban canopy in the two cities which are currently

composed of scattered, aging trees of very few species (majority are Norway Maples which are highly vulnerable to the Asian Longhorn Beetle and other invasive species). It will increase the species and age diversity of the urban forest, making it more resilient to future pest and storm impacts, and allow the neighborhoods to retain more tree cover after significant hurricane wind events.

Vulnerable populations: The entire cities of Greenfield and Springfield are LMI. The vulnerable populations will benefit from reduced flooding, reduced pollution in nearby waters, reduced risk of high wind, and reduced costs of cooling and heating. The model for planting trees in urban low income neighborhoods has been proven in Worcester, Chelsea, Fall River, Revere and Chicopee. EEA has been successful in hiring tree planting crews from the low income neighborhoods where the planting occurs. EEA works with local grass roots human services/environmental organizations to assist with finding local job candidates. EEA also contracts with one local non-profit per city to help with education, marketing and tree maintenance. This creates additional jobs in the neighborhoods. The 5 year planting operation will be divided into two tree planting teams - one for Springfield and another that will work in both Greenfield and Springfield. Based on past performance, each 11 person crew can plant 800 trees (6-10 feet tall) per year (400 in spring, and 400 in fall planting seasons). The full time equivalent of each crew is 6.5 (2 full time foresters and 9 half time crew members), so between the 2 crews there would be 13 FTE's for five years. The foresters will receive training from the GGCP supervisors and Re-Green Springfield experts and the foresters will train the 9 member crews so that high quality plantings take place and crew members can gain training to help them advance to permanent arboculture jobs. In the past year, several of the crew members hired by

the GGC have found permanent jobs in City DPW crews or private landscaping firms so the GGCP is an effective job training program.

Metrics: Resilience Value - reduced downtown neighborhood peak summer temperatures when compared. See attached MassSave Report and BCA; Environmental Value - reduced stormwater flows into adjacent rivers from future storm events; Social Value - reduced energy costs to low income neighborhood residents; Economic Value - number of jobs created in tree planting and care program within the neighborhoods.

Periodic Evaluation: DCR issues a progress report at the end of each planting season (twice a year), which includes details on the plantings, program expenditures, maps of specific tree locations in each community, and other pertinent information. The latest report from the spring of 2015 is attached as an example. Also, UMass Amherst is currently under contract with EEA to study paired neighborhoods in three cities where energy planting will/will not occur to monitor neighborhood temperature, wind speed, energy use, etc. This type of monitoring would be expanded to include stormwater water quality and quantity with UMass with the HUD grant.

Feasibility: The procedures developed by the GGCP in partnership with the cities where the Commonwealth is currently working are proven. All tree locations are selected in concert with local residents and businesses and all locations are checked with Dig Safe to ensure that there are no pipes or wires in the way. For Springfield, the USDA Grant will include an engineer to complete final designs for the stormwater tree filters adjusting the standard design (Tetrattech, 2015) to the specific site. Teams of students from the Conway School of Landscape Design will also design three streetscape renovations (for streets that will undergo major repaving operations during the grant period). The model will be replicable because the stormwater tree filters are more cost-effective to install when other construction projects are underway. A prevalent

challenge in cities is to coordinate the DPW and Water and Sewer Departments so that street construction projects are seamless. The grant in Springfield will demonstrate the benefits of this coordination and show that adding tree filter installation to multi-million dollar street projects (that are capitalized over many years) is a cost-effective way to routinely add tree filters to a city's toolbox. Based on this Springfield experience, we know that our HUD-funded efforts will be feasible in all other locations.

Consultation. The standard procedure for the GGCP is to engage with the city and neighborhood non-profits. In 2013, EEA worked with the City of Springfield and ReGreen Springfield, an organization that was founded in response to the tornado damage, to successfully plant 1,100 trees with a \$390,000 U.S. Department of Energy Grant. The City oversaw the contract and ReGreen Springfield completed the neighborhood outreach. This collaboration is in place for the proposed planting in Springfield. In Greenfield, EEA reached out to the Town of Greenfield and the Greenfield Tree Planting Committee, a non-profit dedicated to tree planting in Greenfield. EEA is also interested in working with the Franklin Land Trust through a pending US Forest Service grant to support tree planting in Greenfield. In addition, our partner FRCOG has worked with the City on tree planting and tree filter/green infrastructure projects in the recent past.

Scalable and Replicable: The GGCP started in one city (Chelsea, MA) and has expanded to four additional cities in one year with plans to expand to eight additional cities in the next year. HUD funding will expand this effort to Springfield and Greenfield, and add a critical new program component – stormwater tree box filters. These filters have been implemented on small scales in several cities including Portsmouth, NH. With support from HUD, this project can be demonstrated to be replicable to all cities across the U.S. and would have a widespread positive impact on climate resilience via increased storm resilience (less stormwater), reduced energy use

(less carbon emissions), reduced peak summer urban temperatures (reduced Urban Heat Island Effect), reduced energy bills, more local jobs (for tree planters and nursery workers – nurseries are MA largest agricultural sector), reduced air pollution, improved health (trees filter significant amounts of pollutants) and extended pavement life (shaded pavement lasts significantly longer).

Schedule and Budget: The following planting plan is proposed for target areas: the program would hire the two crews by the fall of 2016 and would complete the 2,675 trees by the fall of 2018 – and begin planting the “match” trees in the fall of 2018. The tree filters would be installed beginning the fall of 2016 and 28 filters would be planted each fall and spring season completing the project at the end of the spring of 2018.

Tree Plantings

Community	# Riverfront EJ Neighbor- hood Acres***	# Public Trees (40% of trees)	# Private Trees (60% of trees)	Total # of Trees	PUBLIC Tree Planting Cost* (HUD)	PRIVATE Tree Planting Cost* (EEA)	Total Cost
Greenfield (5 trees/acre)**	193	386	579	965	\$366,700	\$332,925	\$699,625
Springfield (2.5 trees per acre)	2,834	2,834	4,251	7,085	\$1,629,550	\$2,444,325	\$4,073,875
TOTAL	3,027	3,220***	4,830	8,050	\$1,996,250	\$2,777,250	\$4,773,500

*\$575 per tree, including labor and watering, except Greenfield public trees average \$950 per tree because they are street trees needing heavy equipment and structural soils for good success. Springfield street trees for the planting zone are included in the Springfield HUD proposal as their DPW has expertise with street trees and EEA has expertise with public right of way and private trees

**The proposal has 5 trees per acre in Greenfield where the HUD and EEA match will plant for this density which EEA has found to be a density that significantly reduces stormwater and energy usage in Environmental Justice neighborhoods with low canopy cover and poorly insulated residences. For Springfield, the Springfield HUD grant proposes 7,000 street tree plantings (2.5 trees per acre in the Resiliency Zone) and EEA proposes 2.5 trees per acre within the resiliency zone and adjacent watershed CDBG eligible neighborhoods to reach the 5 trees/acre goal).

*** Public trees include appropriate planting sites at public schools, playgrounds and other public lands as well as the MA Shade Tree Law (MA General Law Ch. 87) 20-foot public buffer adjacent to sidewalks. These are the types of plantings that EEA and its DCR crews have extensive planting experience with in Worcester, Fall River, Holyoke and Chelsea.

Tree Filters

Community	Target Riverfront EJ Neighborhood (acres)*	No. of Tree Filters	Equiv. Square Ft. of pavement removal	Cost (HUD) (\$11,786 installed based on EPA grant estimate)
Greenfield	193	12	12,000	\$141,432
Springfield	2,834*	25	25,000	\$339,650**
TOTAL	3,027	37	37,000	\$481,082

Grand Total HUD Request: $\$1,996,250 + \$481,082 = \$2,477,332$

*Target neighborhoods were mapped based on City of Springfield Resiliency Zone with further focusing after EEA GIS analysis of orthophotos and tree canopy cover for the above downtown, riverfront neighborhoods. For tree filters, both the Springfield and EEA proposals include 25 tree filters to be located in two focus watersheds within the Resiliency Zone as a pilot program to be expanded after initial measurements.

** \$45,000 is added to the installed cost of the tree filter for design and engineering for each location – these costs are included in the USFS grant for the Springfield proposal.

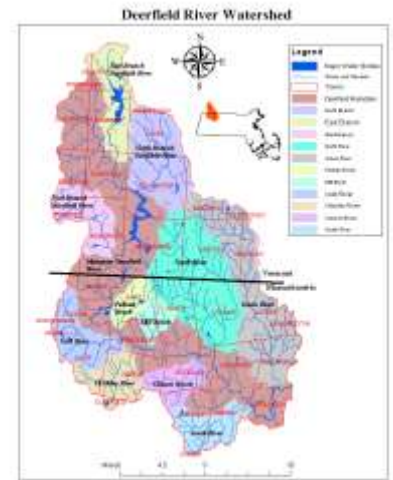
The \$950 per public tree and \$575 per private tree cost includes all aspects of tree purchase and installation and installation watering via tree planting crews. These costs are based on bids received by DCR and actual tree planting costs to date. Public street trees are considerably more expensive because they are larger in size, more complicated to install, and planting often requires concrete cutting and/or the use of heavy equipment. Private trees, on the other hand, are smaller and are hand planted in favorable locations. Public trees are purchased by DCR from state contract and delivered to the municipality, so that the Target Areas do not incur any costs for the trees. The Target Areas are expected to participate in the planning, selection, and planting process and provide in-kind staff time to the program.

B. The Connecticut River Valley

Project 2. Deerfield River Watershed Resiliency Project

Lead: EEA Partners: FRCOG, MassDOT, DER, DEP, FRCOG, Trout Unlimited, UMass-Amherst,

Project Background: The Connecticut River Valley was impacted by five of the six federally declared disasters that qualify under this NOFA. Of them, Tropical Storm Irene in August 2011 caused significant flood-related damage. The storm resulted in estimated economic damages of over \$34 million for individual residents and municipal infrastructure.² Damage to state infrastructure was much greater, with repairs to Route 2, the main lifeline in the Deerfield river watershed, alone reaching \$34 million.



Our projects in the Connecticut Valley represent a dual approach to climate preparedness - creating watershed resilience while also facilitating economic vitality in the region (Att E-Fig E-1). The Valley is one of the more economically depressed parts of the state, which has a particularly hard time bouncing back from disasters. This region reflects social dynamics such as wide rural-urban gradients, varied topography, socio-economic inequity at both the household and community levels, and a unique culture that balances a strong sense of community with a fierce love of independence. There exists a great need for strategies in this valley that simultaneously address the population's low socio-economic status and limited resilience to flood and other disaster-related impacts. Making this region resilient is a combination of fostering economic vitality while creating a stable landscape on which the settlements inhabit. Without economic revitalization, even with a stable riverine system the communities, especially vulnerable populations will not have the capability of recovering from an extreme event; and

² PVPC Climate Action and Clean Energy Plan. Original citation: Massachusetts National Guard. Hurricane Irene Response. August 2011.

<http://states.ng.mil/sites/MA/PDF/Mass%20Guard%20Hurricane%20Irene%20Storyboard.pdf>.

without a resilient watershed even an affluent area will face huge losses from real estate losses and devastation of public infrastructure from flooding and other climate impacts. The Deerfield River watershed, a tributary of the Connecticut River Watershed, in both MA and VT, has been ravaged by many storms that destabilized the riverine system and floodplains and impacted communities in the watershed (see Exhibit D). In particular, intense rainfall and flooding from Tropical Storm Irene washed out roads and culverts, eroded stream banks and displaced significant amounts of sediment. Today, undersized culverts and bridges remain one of the most vulnerable links in transportation and municipal infrastructure in the watershed, including the towns of the Deerfield River Subwatershed Target Area.

Through this Deerfield River resilience project, culverts will be sized in accordance with new stream crossing standards that accommodate larger flows. The Target Area vulnerable populations will experience less impact to their properties, road connectivity will be maintained and the communities will be able to reach other areas of town after a storm event. This project is an integrated approach, with green and gray infrastructure, to help maintain stability in hot spot segments of the river. This project provides resources and direct assistance to communities to better plan and implement disaster recovery that will make the watershed as a whole more resilient to future threats or hazards, including extreme weather events and climate change, while also improving quality of life for existing residents and making communities more resilient to economic stresses or other shocks.

Project Description. The MA Team proposes to develop tools, approaches, and financial assistance for climate resilience-building in the Deerfield River subwatershed to i) replace at-risk, vulnerable road-stream crossings with safe structures that meet statewide Standards, ii) integrate green infrastructure to foster natural buffering capacity, and iii) assist communities as

they develop their own plans for flood resilience and economic opportunity by developing and providing the necessary information and support to ensure that their visions become reality. This watershed resiliency project will be based on sound science developed by researchers at UMass-Amherst, U.S. Geological Survey, and FRCOG and will provide a cost-effective means of stabilizing riverine channels and banks while recognizing and accommodating the watershed's natural hydrology. Culverts will be designed to accommodate future streamflows and green infrastructure will be designed to help recharge stormwater, modulate streamflows, and stabilize areas of high river energy. The watershed will be made more resilient to events of extreme flows, excessive sedimentation, and destruction due to woody debris. Relieving restrictions to flow and stabilizing the natural system will protect adjacent roads, water supplies, power lines, bridges, and water quality upon which the Deerfield River Subwatershed Target Area depends.

Schedule & Budget: The overall project will be completed in 5 years and will require a waiver from HUD. The different activities will occur simultaneously, some starting in 2016 while others will begin in 2017 as the results of other studies will become available. The overall budget for the river resiliency activities for this project is \$23,675,146 of which \$1,030,349 comes from local sources and is direct leverage and \$22,644,797 is our request from HUD. The individual activities below include budgets and schedules.

Activity 1. Planning - Watershed Vulnerability Protocol, Tools, and Assessment

1.1 Develop Pilot Roadway Stream-Crossing Vulnerability Assessment Framework & Prioritization of Culverts. *Lead Entity: MassDOT*

Since September 17, 2014, MassDOT, in collaboration with UMass-Amherst has been developing risk-based and data-driven protocols for assessing extreme flood vulnerability of

roadway stream-crossing structures within the Deerfield River watershed. These protocols incorporate consideration of potential climatic stressors and risk factors, including present and future flood hydrological conditions (based on precipitation under future climate change conditions), geomorphic stability, structural flood resilience, potential emergency response service disruptions, and the ability of the natural ecology of the watershed to accommodate flooding impacts. The goal is to develop a systems-based approach to improve the assessment, planning, prioritization, protection and maintenance of roads and road-stream crossings, and to provide a decision-making tool to be used during project planning and development phases. This will enable MassDOT to proactively upgrade structures vulnerable to extreme weather impacts and future climate change, rather than responding reactively after failures occur. Using these protocols, MassDOT will develop a transportation stream-crossing vulnerability assessment framework that can be systematically and cost-effectively applied to the Deerfield River subwatershed, and ultimately to the rest of the Commonwealth. It will be a decision support matrix – ranking each road-stream crossing based on condition, exposure, sensitivity, ecological passage, and emergency services disruption potential – that will facilitate prioritization of management actions that address significant threats to the safety of the state transportation network and/or regional ecosystem continuity due to climatic changes.

Budget: This assessment work is fully funded by MassDOT and will be completed in 2016.

1.2 Develop Mapping of Hazards and Vulnerabilities

i. Fluvial Erosion Hazard Maps.

Lead Entity: UMass and FRCOG

State Geologist Steve Mabey of UMass-Amherst and FRCOG have developed prototype [fluvial erosion hazard maps](#) for portions of the Deerfield River subwatershed (Pelham Brook in Rowe, East Branch of the North River in Colrain, segments of Clesson Brook in Buckland and the

Green River in Greenfield, and the entire South River subbasin). These maps were developed using the well-established Vermont Agency of Natural Resources' protocols for Phase 1, Phase 2 and Phase 3 Stream Geomorphic Assessments protocol. To minimize future sediment loading into the river and onto watershed lands, erosion zones throughout the watershed need to be identified and mapped for the parts of the watershed that directly impact the Deerfield River Subwatershed Target Areas – mainstem of the Deerfield River; Cold River, Chickley River, and Mill Brook, which all discharge into the Deerfield in Charlemont; the rest of Clesson Brook, which discharges to the Deerfield in Buckland; the West Branch of North River, which runs through Colrain and discharges to Shelburne Falls (Shelburne and Buckland); and the portion of the Green River immediately upstream of and discharging into Greenfield. The additional segments of fluvial erosion hazard maps will indicate areas having very high (where scouring occurs) or very low (where deposition occurs) specific stream power as determined from the stream power mapping in the MassDOT culverts protocol study. This will ensure consistent, science-based, single-methodology generated maps in the VT and MA portions of the watershed. Maps will be used during selection of sites for culvert replacement and green infrastructure.

Budget and Schedule: Project will cost \$500,000 beginning in 2016 and ending in 2018.

ii. Flood Inundation Mapping *Lead Entity: EEA-DCR, Office of Water Resources*

Following Tropical Storm Irene, flood inundation maps for the Deerfield River in the towns of Charlemont, Buckland, Shelburne, Conway, Deerfield and Greenfield were created to assist land owners and emergency management workers to prepare for and recover from floods. This point-and-click visualization tool (https://eater.usgs.gov/osw/flood_inundation/), combined with near-real-time stream gage information provide the local residents with information to assist flood

response activities, such as evacuations and road closures—as well as post-flood recovery efforts. However, some river reaches within the Target Area communities still remain to be mapped; this activity will complete the data collection and mapping for the: (1) Green River in Greenfield, (2) Deerfield River from the Green River to the confluence with the Connecticut River, and (3) Deerfield River in Buckland /Shelburne Falls river reaches. For this activity, we will require: i. installation of a streamgage in each river reach and collection and analysis of data for two years; ii review of the calibration of existing HEC-RAS hydraulic models for each river reach; iii. new flood-inundation maps, and; iv. a report documenting the work, and; v. web-application of the maps.

Additionally, projections of potential changes in the water-surface elevations of the 1-percent annual exceedance probability flood discharge in 25, and 50 years from the present will be evaluated. This evaluation will be performed for the three proposed flood-inundation (FIM) mapping study reaches, and three recently published (2015) FIM studies. The projected effects of climate change on flood magnitudes and inundated areas will be based on observed trends in annual peak flows at stream gages in relatively undeveloped watersheds in the Deerfield River Subwatershed, supplemented by a recently completed statewide analysis of trends in observed annual peak flows. Flood inundation maps will also consider predictions of precipitation for the region using global climate models. HUD funds will be used to develop the predictions; provide a peer review and publication of the findings; and translate the findings into potential design metrics, such as projected design storms with specified return frequencies that are typically used by the engineering design and developer communities.

Budget and Schedule: Project will cost \$508,000 beginning in 2016 and ending in 2019.

Activity 2. Grey Infrastructure – Culvert Re-Design and Construction

Lead Entity: DER and MassDOT

The MA Team will use the risk-based and data-driven protocol being developed by MassDOT and UMass-Amherst, including color-coded maps of stream-crossings at risk, for assessing present and future extreme flood vulnerability of roadway crossing structures and to prioritize 15-20 culverts for removal, resizing, and replacement. Culvert replacement sites will be selected based on the following: 1) vulnerability to flooding under current climate scenarios; 2) vulnerability under future climate scenarios; 3) likelihood that a catastrophic blow-out at a site would disrupt emergency services that rely on the road; and 4) potential of a culvert replacement to restore ecological processes and increase ecosystem resiliency. MassDOT and DER will conduct preliminary prioritization of the culverts, which will be further refined and validated by the Deerfield Creating Resilient Communities Group.

For town-owned culverts, DER and AECOM will work with local governments in the Deerfield River Watershed Target Area to replace approximately half of the culverts with structures that meet flood and ecosystem resiliency goals. Replacing undersized culverts with larger culverts or bridges is a complex process involving specialized field work, hydrologic and hydraulic analyses, an understanding of road use requirements, engineering around existing infrastructure and utilities, and risky construction work in and around free-flowing water and sensitive habitats. Simply placing a larger culvert in a stream without this assessment may result in continued road and culvert failure or an even more catastrophic situation that impacts nearby infrastructure, utilities, and/or habitat. Few municipal DPWs can carry out this work in-house without guidance and additional resources. Few DPWs have the skills or staff capacity to contract this highly technical work to others. Through its 2015 Needs Assessment, DER found that DPWs often replace failing culverts “in-kind” (with the exact same structure) to avoid the

complex and costly technical process required for upgrading culverts and to circumvent complex regulatory processes-for which they have no capacity to complete. It also revealed that municipalities face barriers at all steps in the culvert replacement process including lack of in-house expertise with design of culverts; inability to identify which culverts are most vulnerable to washouts; lack of funds for engineering and design; difficulty with the permitting process; and lack of funds for construction. This bandaid approach leads to repeated culvert failure and road washouts at the same sites, resulting in more impact and expense to municipalities in the long term. The MA Team will work with municipal staff to increase their capacities to lead and oversee the technical and logistical work associated with cost-effective culvert replacements, meeting improved standards and helping them locate additional resources and sources of funding. HUD funding will be used to provide direct technical services related to planning, analyses, engineering and design, permitting, and construction of culverts and for related services such as environmental reviews and helping communities complete planning, prioritization and analyses that will help them seek future sources of funding.

For state-owned culverts, MassDOT will take the lead and develop a contract of packaged culvert adaptation projects, which in coordination with DER and AECOM, it would design and permit. MassDOT will be institutionalizing the use of the Deerfield Vulnerability Assessment protocols. MassDOT will also rely on a new web-based Application (MaPPS) for planning and project development, automated analysis, reporting and collaboration that includes the MassDOT Inventory of Flood Prone Areas, FEMA Flood Hazard Areas, and a suite of wetlands and waterways associated datasets, and is intended to provide a user-friendly, means of populating Project Need and Project Initiation Forms, mapping project limits, sharing project data, and coordinating among internal and external stakeholders. MaPPS will help MassDOT

achieve its climate change adaptation goals through incorporation of adaptation, safety and ecological design considerations into project scopes-of-work during early planning phases. MaPPS was developed in collaboration with FHWA. Another new web-based mapping application under completion, the MassDOT Mapping Our Vulnerable Infrastructure Tool (MOVIT), will allow staff to identify and map information on assets that are vulnerable to extreme weather. Data collected will be used for project development, design, and operations and maintenance.

The MA Team will rely on a newly established interagency “SWAT” team to streamline agency review and permitting, and provide enhanced community assistance, how-to guides, and cluster master service agreements to deliver economies of scale services to local communities. MA has been working since 2000 with the Stream Continuity Partnership, a coalition of agencies and non-governmental organizations that includes DER, MassDOT, MassDEP, UMass Amherst, The Nature Conservancy, American Rivers, and other partners who have developed standards for culverts and bridges that provide flood and ecosystem resiliency; developed a culvert assessment method and used it to survey more than 5,000 culverts and; completed culvert upgrade demonstration projects in nearby watersheds. Stream crossing standards (Standards) first developed by DER were incorporated into the MA Wetlands Protection Act regulations in October 2014. These updated regulations also include a new Wetland/Ecological Restoration General Permit which streamlines restoration projects including dam removals, freshwater and tidal culvert improvements, stream daylighting, restoration of rare species habitat and the improvement of fish passage. To comply with the Standards an applicant needs to consider downstream flooding, upstream and downstream habitat, potential for erosion and head cutting, stream stability, habitat fragmentation caused by the crossing, and the ability of

crossings to convey storm flows. Research has shown that culverts built to new design standards such as these can save municipalities money and protect municipalities from the effects of large storms (DER 2015).

Budget and Schedule: The project will cost \$15,000,000 for a period of five years beginning in 2017.

Activity 3. 'Green by the Stream' - Riverine Green Infrastructure Design and Construction

Lead Entity: FRCOG and TU

Green infrastructure improvements will complement newly designed stream crossings, incorporate habitat connectivity design elements, and provide longer stretches of stable riverine systems to buffer and protect vulnerable populations and their communities. On a watershed scale, green infrastructure is a network of conserved and working lands (forests, floodplains and wetlands) and restoration projects that will improve disaster resilience and provide essential environmental functions such as supporting biodiversity and water resource protection. On a local scale, green infrastructure includes small-scale features such as urban forests, tree box filters, bioretention areas, grassed swales and riparian buffers that contribute to stormwater management, improved air quality and minimized heat island effects.

With a grant from EEA's DEP, FRCOG is compiling baseline data on watershed conditions, estimating pollutant loads from destabilized riparian locations, conducting a comparative subwatershed analysis to identify priority areas for interventions, conducting watershed field inventories, reviewing land use regulations, and performing a green infrastructure assessment. FRCOG is developing a comprehensive Deerfield River Watershed-Based Plan that integrates the statewide Watershed-Based Plan strategy, the EPA's Healthy

Watersheds Initiative, and climate change adaptation strategies. The plan will include measurable actions to protect and improve water resource conditions and climate change resiliency, including recommendations for hot spot reaches and stretches upstream and downstream of affected culverts that would benefit from installation of green infrastructure techniques in the Deerfield River Subwatershed Target Area.

Working from this list of green infrastructure project locations and using the erosion hazard and flood inundation maps, the Leads will match prioritized restoration sites in the target areas with green infrastructure interventions, which in combination with the re-designed culverts will increase resilience along broader stretches of the watershed. For the North River that directly leads into the Shelburne Falls Target Area, they will review the flood resiliency projects already identified in the fluvial geomorphic and habitat assessments completed for these watersheds by FRCOG and consider them for addition to the prioritized list. The prioritized sites will be further vetted with the Deerfield Creating Resilient Communities Group. In addition, Trout Unlimited will implement river and floodplain stabilization practices to allow the river to flow naturally, remove constrictions, slow water down, and reconnect to its floodplains. This work will expand and complement similar work by Trout Unlimited in the Vermont portion of the Deerfield River watershed. AECOM will prepare final designs, obtain environmental permits, and advise on selection of contractors to build the green infrastructure projects.

Budget and Schedule: \$6,000,000 and project will be for 5 years beginning in 2017.

Activity 4. Technical Assistance and Target Area Capacity Building

Lead Entity: DER, and EEA

The MA Team will build community capacity by providing technical assistance, and tools to municipalities. We will build community capacity related to re-designing of culverts by

providing technical assistance, tools, and through direct funding to municipalities. The MA Team will work with DER, regional planning agencies, the Deerfield Creating Resilient Communities Group, MassDOT, and others to develop and deliver an implementation guide, based on identified needs, to help the towns implement culvert replacement projects that meet flood and ecosystem resiliency objectives. In particular, DER will provide direct assistance to the Target Area communities related to planning, analyses, engineering and design, and construction of culverts, completing benefit-cost analyses required for FEMA/MEMA Hazard Mitigation Plans. Example elements may include but are not limited to: a. Standard culvert replacement designs and/or plan details that can be used at sites that share common characteristics (i.e., small, steep stream flowing under a two-lane road). Examples include engineering plans and details on guard rails, abutments, sidewalks, bike lanes, utility protection, and bank restoration. b. generalized scopes of work for culvert related engineering and technical analyses tasks that Towns may not be able to complete in-house, paired with a suite of pre-qualified engineers skilled at carrying out tasks such as specialized field work, hydraulic and hydrologic analyses, engineering around infrastructure and utilities, and in-stream construction work. c. training for town staff on topics such as how to navigate the regulatory process; how to choose an appropriate culvert size for a given stream width, depth, and discharge; design and construction techniques that result in structurally sound, stable culverts; and how to install a culvert using town-owned heavy equipment.

Budget and Schedule: \$536,797 and project will begin in 2016 and will continue for five years.

Activity 5. Planning – Climate Resiliency Outreach to Low Income Populations

Lead Entity: FRCOG

FRCOG will conduct a planning and public outreach study to engage low and moderate income and minority residents in activities designed to educate them about the impacts of climate change and ways to increase the resiliency of their neighborhoods and households. Climate change poses a threat to all of the Deerfield River Watershed communities; however, the more urban and developed areas of the watershed are unique in that they include some of our most vulnerable populations. These areas are plagued by outdated infrastructure and significant areas of impervious cover that exacerbate flooding and contribute to the “heat island effect”. There is a need to create urban resiliency strategies that will be embraced by the people who live in these communities. Many of these residents, living on limited incomes and grappling with other problems, are focused on meeting the day-to-day challenges of their lives and probably haven’t given much attention to climate change impacts and resiliency strategies. Developing specific outreach strategies and community projects, such as tree planting, community gardens, and weatherization projects, that build household, neighborhood and community resiliency is the ultimate goal of this project. Our project focus area will include the most populous and urban area in the Deerfield River Watershed, Greenfield.

This planning process will focus on the following areas: education about climate change and tools and actions for adaptation as developed in the above projects, green infrastructure; food security and access; shelters (warming and cooling centers); energy efficiency and renewables. This will be a collaborative effort with other regional organizations (e.g. Franklin County Regional Housing & Redevelopment Authority, Community Action & Franklin County Home Care) and municipal officials. We will identify specific outreach processes and activities in collaboration with our regional partners. An Action Plan for Resilience Strategies for Under-Served Communities will be developed and include specific recommendations and outreach

materials. This project model is envisioned to be scalable and transferable to other rural urban areas as well as more populated urban areas.

Budget and Schedule: \$75,000 (\$45,000 to FRCOG; \$30,000 to Regional Partners).

Activity 6. Community Outreach

Lead Entity: FRCOG

FRCOG will engage in a comprehensive public outreach program targeted to municipal officials such as Boards of Selectmen, Planning Boards and Conservation Commissions, and regional organizations to identify next steps for implementation (e.g. site selection, feasibility study, design and environmental permitting, and engineering plans). Through public outreach methods and activities that would include neighborhood and community meetings, on-line and paper surveys, social media, community projects/events, and workshops, community members, including agricultural business owners and low and moderate income households, will weigh in on site selection, the benefits of improved streamflow passage and the potentials for interrupted traffic patterns during construction. They will also craft sustainable visions of their communities' relationships with rivers which may include delineations of flood hazard, green infrastructure, and economic opportunity zones.

Budget and Schedule: \$25,000, for a period of five years.

Tie Back: The River Resiliency project will directly address infrastructure failure and riverine flooding that occurred as a result of Tropical Storm Irene. Infrastructure will be resized using updated design standards to accommodate higher flows, and riverine systems will be stabilized through green infrastructure to reduce erosion and help buffer some of the flow.

Unmet Need/National Objective: These activities directly meet unmet need in the target communities in the Deerfield watershed. They also benefit some upstream and downstream

communities that influence the target areas. Our target areas are based on LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: Rainfall records in MA from the last 100 years clearly shows that average precipitation, and the extent and frequency of extreme precipitation has increased in the last 4 decades (MA Climate Change Adaptation Report-<http://www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html>; MA Water Resources Commission, 2008; Douglas and Fairbank, 2011). However, culverts have been sized using 50+ year old precipitation data making them inadequate for today's rainfall, let alone future rainfall. A recent study in Vermont found that recently improved culverts survived Tropical Storm Irene undamaged, whereas nearly 1000 traditional culverts were destroyed or damaged by the storm (Gillespie et al., 2014). Post-Hurricane Irene research conducted in the northeast by the USDA Forest Service and others has shown that larger culverts and bridges keep communities safe and prevent environmental degradation during large storms (USDA Forest Service 2014). Upgraded culverts meeting MA Stream Crossing Standards have been shown to pass a 100-year flood (Zarriello and Barbaro 2014).

Additionally, recent research by DER suggests that while proactively upgrading culverts and bridges can cost more money in the short-term, the larger structures save communities money in the long term, compared with maintaining and repairing the original undersized crossings over a 30-year period. This project will give communities in the Deerfield badly needed landscape and watershed resiliency to withstand extreme weather events in a changing climate. Local infrastructure will be able to withstand greater flows, the landscape will have more natural areas to help minimize stormwater, hold water back; and most importantly

communities will be enabled to plan for long-term climate resilience by benefiting from direct technical assistance.

Vulnerable Populations: Ideas for this project were generated through a bottoms-up approach by working with a local river resiliency group that represents the needs and issues of the local LMI population. The project will enable municipalities to build up the resilience of local systems, minimizing impacts to environment and infrastructure of the LMI residents.

Metrics: *Resilience Value* - Reduced vulnerability to infrastructure; reduction in flow impacts and property damage; reduced displacement by future disasters; *Environmental Value* - stabilization of the river in particular and the watershed as a whole; ecosystem effects; a more resilient landscape to support healthy communities; *Social Value* - Direct benefit to target LMI areas; *Economic Revitalization* - indirect impacts to local economy because of a decrease in disruption of transportation pathways, minimized property losses from flooding.

Periodic Evaluation: The projects will be evaluated throughout their life cycles from project scoping to final on-the-ground implementation to ensure that they meet the requirements of all environmental and other permits, design standards, create climate resilience in the target communities, and continue to have secondary benefits to the watershed and its residents.

Feasibility. The river resiliency project is highly feasible given the strong community input and support, the inherent strengths and expertise of the state agencies, and the additional support, know-how, and technical expertise provided by our academic, non-profit, and regional planning partners. Our key local stakeholder group, the Deerfield Creating Resilient Communities (CRC) group, consists of federal and state agencies, municipalities, environmental groups, UMass Amherst researchers and residents from both VT and MA. UMass Amherst scientists have riverine, geologic, and fluvial geomorphic expertise and are developing tools and support for

flood preparedness, strategies for riparian land management to maximize overall watershed/river health and minimize damages. DER has recently (2013) established a Stream Continuity Program, allowing them to focus directly on building community capacity for increasing the pace and scale at which culverts are upgraded, to improve both flood resiliency and ecosystem health.

Consultation: These projects were developed through a two tiered process: first, coordinating with a core group of Deerfield River Subwatershed based researchers, local planning agencies, state and federal agencies, nonprofit groups, and a few other members of the ‘Deerfield Creating Resilient Communities’ group, to hone in on ongoing and recently completed research, assessment, and implementation projects, and identify infrastructure and environmental needs for the watershed. Additional one-on-one conversations with these and other stakeholders filled information gaps and precipitated in the development of most important needs. Project ideas that emerged met these needs and were initially vetted with this core group, and further discussed and fine-tuned with the full Deerfield Creating Resilient Communities group, as well as a state interagency group.

Scoping/Scaling: If MA is asked to scale this project, fewer culverts will be resized and fewer green infrastructure elements can be incorporated. However, this would leave the high priority culverts at risk during the next storm event, since many are already compromised from previous disasters like Irene. The Commonwealth will pilot this program in the Deerfield River Watershed for five years, evaluate its success and begin to transfer throughout the state and especially in other vulnerable areas the lessons learnt, and products generated through the institutional mechanisms that are already in place. The vulnerability assessment frameworks and the prioritization mechanisms can be systematically and cost-effectively applied to the rest of the Commonwealth.

Project 3. Fix-it-First (MID-URN Qualifying Project Repairs)

Several areas were identified as being Most Impact and Distressed and having Unmet Recovery Needs, allowing them to qualify as NDRC Target Areas (Exhibits B and D). The MA Team is proposing to make repairs to those unmet recovery needs that are shovel-ready in the Deerfield River Subwatershed and Williamstown Target Areas.

Tie Back: As a result of Tropical Storm Irene, there is unmet recovery need affecting the Deerfield River subwatershed and Williamstown (Exhibits B and D). Meeting these needs directly ties back to the disaster and will improve infrastructure and environmental conditions.

Unmet Need/National Objective: All the activities meet unmet recovery needs in the Deerfield River Subwatershed and Williamstown Target Area. In addition, distress in the Target Area is based on LMI, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: Extreme events of rainfall and flooding have increased and predicted to further increase under climate change. Without repairs to the identified unmet recovery needs, the Target Area is vulnerable to another blow-out of the Trout Brook culvert at Route 2 in Charlemont and continued or worsening cross-contamination of stormwater and wastewater at the Maple Brook Culvert and Sewer in Greenfield. With the bridge abutments already destabilized at Nash's Mill Bridge and only one lane of traffic allowed on the bridge at a given time, the bridge is at risk of completely closing should it be affected by another flood. Finally, additional loss of ground and inundation of the electrical facilities could close the water supply to the Shelburne Falls and contribute to the environmental degradation in the North River in Colrain.

Vulnerable Populations: LMI populations are directly affected by these unmet recovery needs, as demonstrated in Exhibits B and D. Road closures from culvert and bridge damage significantly increased distances and travel time, costing poor families more in time and fuel and forcing school buses and fire trucks to seek alternative routes. Another large flood could again cut access to Route 2 and flooded wells causing the loss of water supply.

Metrics: *Resilience Value* - Reduced vulnerability to water infrastructure; reduction of expected casualties from future disasters; *Environmental Value* - Ecosystem effects from environmental restoration and green infrastructure; *Social Value* - Direct benefit to LMIs; equal access to resilient community assets.

Periodic Evaluation: Progress of all the four projects will be done periodically by AECOM throughout the project implementation period.

Feasibility: These projects are shovel-ready with detailed scopes, cost estimates and, in some cases, complete engineering drawings. What is needed to address the Target Area's Unmet Recovery Needs is clear and the local communities are eager to start on the project.

Consultation: These project ideas were generated as a result of consultation with the Deerfield Creating Resilient Communities Group, FRCOG, and the local communities who have to face the herculean task of funding repairs off of a low tax base.

Scoping/Scaling:

Overall Schedule and Budget:

Activity 3.1. Route 2 Culvert over Trout Brook, Charlemont *Lead: EEA, AECOM, MassDOT*

MassDOT will replace the undersized culvert on Route 2 over Trout Brook in Charlemont with a larger one that will be more resilient to future storms. MassDOT spent \$150,000 to make immediate repairs to the culvert following Tropical Storm Irene, however, the work was limited to restoring the culvert to pre-disaster conditions. While the culvert is in good structural condition, it is undersized and has a stone-lined channel bottom causing restriction of streamflow, particularly during floods, causing scouring, erosion and high flow velocity. The proposed new structure will increase the opening from 80 square feet 230 square feet. The Concrete Arch will provide almost 5 feet of freeboard for the same storm event that currently fills the existing box culvert. The freeboard will allow for passage of woody debris that has potential to plug the opening. Available discharge capacity will increase by 22% and stream velocity will decrease by 38%. Additional freeboard will provide for debris passage, which will greatly reduce the chance for blockage of the structure, thereby reducing the likelihood that the stream will jump its banks and damage Route 2. Constructing a larger structure will slower streamflow velocities, reducing stream scour and bank erosion and allowing improved passage of high flows, debris, fish, and wildlife.

In addition to replacing the culvert, addressing the impacted streambed and bank immediately around the culvert through restoration will improve stream stability under the full range of expected storm flows, and will improve the structural integrity of the proposed stream-crossing structure through robust scour protection. A co-benefit of streambed and bank restoration is to provide trout passage through the structure. An initial assessment at Trout Brook in October 2010 identified an approximate 7% stream channel slope and various challenges to restoring the streambed. Tropical Storm Irene resulted in further bank and streambed destabilization, and may have increased the stream channel slope within Trout Brook. Repairs

were made to bring the streambed back to pre-storm conditions as much as possible. Next steps to providing stability to the upgraded culvert through restoration of the streambed and banks include:

- Re-evaluate potential for streambed and bank restoration, including fluvial geomorphic assessment, stream channel longitudinal profile and detailed survey.
- Develop streambed / bank restoration conceptual plan.
- Conduct construction feasibility assessment to determine whether the conceptual plan could be successfully implemented.
- Develop final streambed / bank restoration plan.
- Construct the streambed / bank restoration as part of the Route 2 culvert replacement over Trout Brook. Restoration would be conducted by a qualified contractor with experience with stream restoration work, and under close supervision by an experienced fluvial geomorphologist.

Budget and Schedule: HUD - replacement of the structure (\$1,167,000) and streambed/bank restoration (\$400,910), MassDOT - \$150,000 for restoration analysis and design with their open Environmental Services contracts and/or Master Service Agreements. Project will begin in 2016 and be complete in 2018.

Activity 3.2. Shelburne Falls Fire District Wells, Colrain *Lead: EEA and AECOM*

This project involves replacement of sensitive electrical controls that run the wells to an upland site to ensure that the wells will not be compromised by another flood. The well pump house and its electrical system will be relocated next to the road, ensuring that electrical system and the well pump house are on safer ground. The project also includes establishing a riparian buffer and

stabilizing the stream bank of the North River in the vicinity of the wells with a constructed bank full bench, introducing boulder deflectors and toe wood structures along 700 feet of eroding bank, and installing of boulder clusters and isolated logs. Additional instream habitat benefits will be provided by the installation of boulder clusters and isolated logs.

Budget and Schedule: Moving the well pump house and electrical system will cost \$219,000 and repairing the streambanks will cost \$460,000.

Activity 3.3. Maple Brook Culvert and Interceptor, Greenfield *Lead: EEE, AECOM, Greenfield*

The Town of Greenfield sustained significant damage to the Maple Brook Culvert and Interceptor during Tropical Storm Irene (see Exhibits B and E). The MA Team will construct a new bypass sewer which is a long-term and comprehensive solution for eliminating the cross-connection from the 24-inch Maple Brook Sewer to the Maple Brook Culvert. This will also address the poor hydraulic connection of the 12 and 15-inch sanitary sewers to the 30-inch Maple Brook Interceptor. Survey data collected by the Town indicate that there is a relatively flat or negative slope of the 12 and 15-inch sewer lines into the Maple Brook Interceptor. These connections result in relatively rapid sediment deposition within the 12 and 15-inch sewers as well as in the 24-inch sewer in the vicinity of Arch Place. This poor hydraulic connection may also contribute to sanitary overflows upstream of this area into the Maple Brook Culvert, especially when the downstream lines contain significant amounts of debris. This project will consist of construction of approximately 975 linear feet of new 30-inch bypass sewer running from structure no. 1 to structure no. 8 as shown on Figure XXX. This will also involve jacking the 30-inch sewer underneath the railroad bed between Chapman Street and Wells Street. This bypass sewer would improve flow hydraulics from the upstream 24-inch sewer into the Maple

Brook Interceptor, would most likely reduce upstream sanitary overflows and would eliminate the 12 and 15-inch connections into the Maple Brook Interceptor which are located underneath the building structure along Wells Street. Although the data collected to date suggests that there are no existing service connections into the 12 and 15-inch sewers, additional investigations would also be performed to confirm that there are no service connections prior to abandoning these lines. Based on the internal inspection of the Maple Brook Culvert and water sample results, additional investigations within the drainage subarea of the culvert will be conducted in an effort to identify the source(s) of high E. Coli sample results within the drain. This will include follow-up inspections along the 18-inch drain into the Maple Brook Culvert along Maple Street. Also additional dye water testing, smoke testing and internal video inspection will be conducted in the upstream reaches of the culvert to identify the sources of the high E. Coli sample results revealed during the culvert's internal inspection. **Budget:** The approximate cost of this work is \$2,000,000 including engineering and contingencies.

Activity 3.4. Nash's Mill Bridge

Lead: EEA and AECOM

Nash's Mill Road Bridge will be replaced in compliance with MassDOT design standards. The bridge's elevation will be raised and the abutment(s) will be moved out from the river bed. The project is presently in final design, which will result in a construction bid package. The MA Team is seeking funding for construction support consisting of construction as well as engineering services during construction (bidding, shop drawing review, and consultation and advice). A load rating report of the completed bridge following the procedures defined in the MassDOT Bridge Design Manual will be prepared in support of this project

Budget: Construction cost has been estimated at \$3,000,000.

Schedule: Project Ready for Construction Advertisement August 28, 2015 Greenfield, MA; will be complete in 2 years.

Activity 3.5. Cole Avenue Housing Project in Williamstown

Lead Entities: Williamstown, DHCD and EEA

The Town of Williamstown has an urgent need for affordable housing. This need has been exasperated by the displacement of 155 households as a result of flooding from Tropical Storm Irene in August 2011. The town has been dedicated to the replacement of those households. The Cole Avenue project in Williamstown will create up to 46 units of affordable family housing consisting of 1, 2 and 3 bedroom units close to the center of Williamstown to partially replace lost housing at the Spruces as a result of Tropical Storm Irene. The project seeks to create new housing opportunities for low income families where few options exist. In a 2013 Housing Needs Survey, several key factors were determined regarding rental housing in Williamstown, MA[1]: Rents are 30-60% higher in Williamstown than surrounding communities and rents are increasing at one of the highest rates in Massachusetts; There has been a trend in Williamstown of losing young, low to moderate income families as well as low income seniors; 35% of all non-elderly households are rent burdened and elderly households face similar rent burdens; More than 62% of residents work in town, which is double the state average; There are significant numbers of low income workers in Williamstown (between 750-1000 workers) who live in surrounding communities, despite the fact that those communities have limited supply of affordable housing opportunities.

As a result of these indicators, the study concluded that this trend will result in long-term declines in the economic vitality of the Northern Berkshires and that the sudden loss of 150 affordable units without replacement will contribute to a trend of significantly less age and

economic diversity. The Town of Williamstown has accepted a proposal to purchase and develop a town-owned property at 330 Cole Avenue in Williamstown at a nominal price. The site is situated close to the heart of the town center close to transportation, schools, and shopping and job opportunities. This property, also known as the Photech site, is a former industrial site which has been vacant since 1990. The site has two existing vacant and deteriorated structures which have asbestos-containing materials and will need to be remediated and demolished. The site itself presents significant challenges. A portion of the site is located within the 100-Year Flood Plain and The Massachusetts Natural Heritage & Endangered Species Program (NHESP) identified approximately half of the site as possible habitat resource area. As a result of these challenges, the nominal price to acquire the property is countered by significant site costs to deliver a site that is developable. To that end, funds will be used to clear and remediate the site including the following scope: i. Survey and remediation of hazardous materials in the existing structures ii. Demolition of the existing structures iii. Re-characterization of soil conditions and required remediation, and iv. Site Plan development to create a plan that avoids sensitive areas while maximizing the allowable number of units that can be created.

The Cole Avenue project is highly replicable. Creating affordable housing opportunities in communities of choice with a local community that supports the effort is something that can be done in other places. The critical piece is to acknowledge that “free land” or even “nominal value” typically involves sites that present challenges and if resources can be identified and marshalled to fund the addressing of the challenges in communities of this nature then it can be a replicable model. Communities of choice in order to grow and thrive long term must feature a degree of economic diversity.

Tie Back: This project ties directly back to the impacts from Irene in Williamstown where flood waters completely wiped out a mobile home park. This project provides a new location for the displaced residents with homes that are resilient to climate change, energy and water efficient, and address stormwater runoff proactively.

Unmet Need/National Objective:

Current/Future Risks:

Vulnerable Populations: As stated previously, based on the 2013 Williamstown Housing Needs Assessment the supply of affordable rental housing opportunities is limited and 35% of low income residents in the town are rent burdened. Despite the fact that Williamstown is a jobs center with Williams College as a major local institution, there is evidence of out-migration of lower income residents to surrounding communities where affordable rental opportunities are still limited. The creation of up to 46 units of affordable family housing will provide a product for a severely underserved market.

The Cole Avenue project will adhere to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing. The project will establish a hiring goal of 30% from the local community and the surrounding communities ensure that the project not only creates greatly needed affordable housing opportunities but also provides quality jobs for area residents.

Resilience: The site at 330 Cole Avenue currently sits vacant with significant environmental hazards amidst a residential community. The remediation and redevelopment of this site will

eliminate a neighborhood blight and potential hazard. The creation of up to 46 affordable low-income family units will address what is currently a lack of supply to support a population essential to the viability of the Town of Williamstown. Given the recent history of Williamstown from the flooding as a result of Tropical Storm Irene, the new development would meet all requirements to ensure a development that is sited out of potential hazard areas and that meets modern zoning requirements which seek buildings that are resilient in the face of changing climate conditions. The town has made environmental resiliency a priority in the face of 2011's tragic storm consequences.

Metrics: *Resilience Value* - Reduction in expected property damage; reduced vulnerability to energy and water infrastructure; restoring and reusing a derelict vacant property with unique access to transit, jobs, retail and convenient opportunities into the Williamstown market to address the needs of some of its most vulnerable residents; *Environmental Value* - Reduced green house gas emissions; reduced energy use; water quality-reduced stormwater runoff; reduced urban heat island effect; Remediating a site that currently houses environmental hazards in the midst of a residential community; *Social Value* - Direct benefit to LMIs; greater household affordability; Preventing the loss of economic diversity essential to the long-term survival of a thriving community by creating affordable housing opportunities that the existing market has long been neglected; *Economic Revitalization* - Increased value of property; Returning a property back to the town tax rolls as well as providing potential workers across the economic spectrum within the town of Williamstown and the larger North Berkshire region.

Periodic Evaluation:

Feasibility: The Cole Avenue project will be designed to meet all established building codes and standards in addition to meet the design guidelines of the Massachusetts Department of Housing

and Community Development. Best Practices will be utilized to achieve green and smart design that is both successful and cost effective both during the construction process as well in long term building operations. The design team for the project has as one of its priorities to create a community that is ideal for families that fosters sustainable design that is sensitive to the environment.

Consultation: This project was developed in consultation with BRPC, the town and low-income housing advocates.

Scoping/Scaling:

Schedule and Budget: \$750,000 and the project will be completed in four years.

Project 4. Charlemont WWTP and Municipal Complex Climate Resiliency

Lead: EEA, AECOM and DEP

The Charlemont Sewer District and the town of Charlemont's municipal complex (which houses the Highway Garage, Fire Department, and Police Department) are located in the floodplain on three parcels abutting the Deerfield River. During Tropical Storm Irene, both the municipal complex and the Sewer District were significantly flooded. The Town of Charlemont's 2014 Local Multi-Hazard Mitigation Plan stated, "Note should also be taken of the fact that the town's wastewater treatment facility lies within the floodplain. There is potential for release of hazardous waste from this facility during a flood"

([http://www.charlemontma.us/sites/default/files/Attachments/charlemont](http://www.charlemontma.us/sites/default/files/Attachments/charlemont_hazmit_finalreviewdraft_7-18-2014-1.pdf)

[hazmit_finalreviewdraft_7-18-2014-1.pdf](http://www.charlemontma.us/sites/default/files/Attachments/charlemont_hazmit_finalreviewdraft_7-18-2014-1.pdf) and see figure AB). Listed as "significant structures within or adjacent to the floodplain in Charlemont" (p. 50 of the Hazard Mitigation Plan), the wastewater Treatment Facility has a total building value in the floodplain of \$700,000, the Fire Station has a total building value in the floodplain of \$177,000 and the Highway Department has

a total building value in the floodplain of \$899,000. These facilities are vulnerable to rainfall, snowfall, hurricanes, tropical storms, and dam failure from Bear Swamp Hydroelectric Dam, owned by Brookfield Renewable Energy upstream from Charlemont. Because the town and the district are two separate and small entities with each having one or two full-time staff and small budgets, working towards a solution is a challenge. This project will include a feasibility study for relocating the municipal complex to avoid future flooding to critical infrastructure and using the available floodplain from the municipal complex's move to enable the Sewer District to construct floodproofing features. The feasibility study will determine the best potential solutions for both entities. The feasibility study will include a survey/ ranking of potential properties to which the town could relocate, factoring into the relocation: that the town's ambulance service has a formal agreement to service two neighboring towns; that one of those towns is also looking to relocate or rebuild a highway garage based on damage from Hurricane Irene and may want to consider sharing a new facility; and that, if a new facility for police, fire, and ambulance could be housed together next to the Town Hall/Library, if the property next door and currently for sale could be acquired and demolished, it could be rebuilt into a multi-use space with a potential senior center/ community center to promote community engagement, enrichment, and town pride. As part of the solution, funds would also be used for demolishing the existing town structures on the towns' parcels. Finally, this project would support acquisition of new property and construction of new facilities.

Tie Back: This project will help floodproof critical infrastructure that the Target Area depends on. The upgrades and retrofits will help make the plants more resilient and prevent future plant failures which could have catastrophic consequences. The project will modernize the plants to be able to withstand future heavy rain events.

Unmet Need/National Objective: This implementation project will directly help our Target Area meet its unmet recovery need as a result of impacts from Tropical Storm Irene. Distress in this area is based on LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: This project will provide the Greenfield and Charlemont, an LMI area in desperate need of assistance, the needed floodproofing of wastewater treatment facilities to withstand high flows that are typical of a changing climate in Massachusetts, and to prevent the release of raw sewage to waterways. Climate change is already causing a shift in precipitation, with more extreme events, and larger high intensity rainfall over a short period.

Vulnerable Populations:

Metrics: *Resilience Value* - Reduced vulnerability to water infrastructure - reduction in plant failures; prevention of flooding at plant; *Environmental Value* - Decreased contamination in waterways; improved water quality of the receiving waters; *Social Value* - Reduction in human suffering-Diminished public health threat; direct benefit to vulnerable LMIs; clean water for public recreation boating and fishing, agriculture and domestic water supply; *Economic Revitalization* - Directly affects local economy. Failure at plants can impact all individuals and businesses. Increased resilience against flooding provides economic benefits by reducing potential structural damage and reducing or eliminating claims under the National Flood Insurance Program (NFIP).

Periodic Evaluation: EEA and DEP will evaluate the progress of this project throughout its implementation. DEP has recently instituted a new Water Utility Resilience Program (WURP) for drinking water (DW) and wastewater (WW) technical assistance. The WURP will engage the system throughout the project to offer assistance in support of enhancing their resilience through

identifying additional resiliency resources, and coordinating useful information relative to comparable projects throughout the Commonwealth.

Feasibility: This project is considered highly feasible. We fully expect the retrofits to be complete within the specified timeline. The Team has the ability to collaborate with additional agencies and other Publicly Owned Treatment Works (POTWs), which will allow us to draw from their experiences with flooding, extreme hydraulic overloads impacting treatment processes, separation of combined sewers, and new technology. This type of collaboration will provide us with lessons learned, and leverage other efforts to best support this project.

Consultation: This project was developed in collaboration with Charlemont and Greenfield and in consultation with the Deerfield Creating Resilient Communities group.

Scoping/Scaling: The list of retrofits can be prioritized and if the project budget is scaled back then implementation can occur for the top priority recommendations.

Schedule and Budget: The assessment of the plants, design, purchase and installation of flood proofing features will cost an estimate of \$2 million. Project will take approximately 3-4 years.

Project 5. Mohawk Trail Woodlands Partnership

Lead: DOER and EEA

Upland forests are the primary defense against flooding and stormwater pollution in downstream cities. This project will increase the resiliency of a largely neglected private watershed forest that protects the Deerfield River and impacts downstream cities such as Greenfield and Springfield. Rather than needing constant public funding, this project will create the private sector markets via innovative wood technology plants that will fuel the restoration of this forest for decades to come while providing good-paying jobs to the most rural and low income region in Massachusetts. This project closely complements the urban tree planting project which improves

the resiliency of the urban forest in cities just downstream of this region. EEA in partnership with FRCOG, BRPC and the Franklin Land Trust (FLT) is proposing the Mohawk Trail Woodlands Partnership to ensure that urban and natural forests are healthy and resilient, and are better able to withstand the forces of hurricane winds, tornadoes, and flooding. This is an innovative forest resiliency project that will 1) reduce storm damage to sidewalks, roads, culverts and other infrastructure; 2) increase the resiliency of the forest to future storms resulting in less future flooding and forest fires; 3) assure continuous heating after severe winter ice and snow storms; 4) create manufacturing jobs in low income rural communities; 5) create markets to pay for storm clean-up of downed trees to reduce future flooding and forest fires; 6) increase the future value of forest products via improvement harvests; 7) retain and create forestry jobs in the harvesting, chipping, trucking and forest assessment sectors; 8) provide income to the thousands of private forest owners who will gain needed income from sale of wood products to these new markets; and 9) improve the forest habitat for declining species through restoration harvests. Ultimately, a wood pellet plant, a cross laminated timber (CLT) plant, and a wood nanotechnology plant will be developed, sited and constructed, and 540 wood furnaces will be installed in schools, public buildings, and residences in the Mohawk Trail Woodland Partnership 20-town region, where the forest covers 80+% of the area. CLT research is already underway by Dr. Peggi Clouston, a professor at the UMass Amherst Wood Building and Engineering Department, with support of a \$390,000 National Science Foundation grant to investigate CLT from low-value Northeastern woods. HUD funding will support a small-scale pellet plant, a nanotechnology plant, and pellet boilers at schools and public buildings in the Deerfield River Subwatershed Target Area.

This project will change a disaster threat from a large and vulnerable forest to a resiliency model – a diverse, thinned and vigorously growing forest via an economic model that will decrease risk to vulnerable populations by reducing storm damage to infrastructure, reducing disruption to loss of winter heating, increase good-paying local manufacturing jobs, increase local tax base, reduce municipal and residential costs through low cost wood heat (about ½ the cost of oil or propane – the only other winter fuels available in this rural region). The project will include a component for technical assistance to local municipal and businesses about the value of wood heat and the value of wood technology for heat, plastics-replacements (wood nanotechnology) and high technology wood building materials. New employment opportunities will include timber harvesters and truckers who work in the forests, employees of the pellet manufacturing facility, employees of the pellet distribution facility, and increases in work for mechanical engineers conducting engineering design, HVAC technicians for installations, and technicians for service/maintenance. As a co-benefit, MA has modeled the use of woody biomass as a climate mitigation strategy and although biomass is not greenhouse gas neutral, as the forest re-grows after sustainable harvests it does demonstrate very positive greenhouse gas reductions over time compared to heating oil.

Development of this project began in 2010, when FRCOG and BRPC each were awarded HUD's Sustainable Communities Planning Grants. In their respective planning documents, both recommended protecting forests and promoting economic development in the forestry sector. With the assistance of the Franklin Land Trust, FRCOG and BRPC have since been conducting a regional public outreach and planning process to determine the level of community and private landowner interest in a new partnership between 20 towns in northwestern Massachusetts and State and Federal agencies. The Special Designation Study Area encompasses 346,053 acres

located in Northwestern Massachusetts and includes the most rural and economically challenged towns in the State. Franklin County – the most rural County in Massachusetts – includes the towns of Ashfield, Buckland, Charlemont, Colrain, Conway, Hawley, Heath, Leyden, Monroe, Rowe, and Shelburne, eight of which in the Deerfield River Subwatershed Target Area.

Berkshire County – Massachusetts’s western-most county – includes the northern towns of Adams, Cheshire, Clarksburg, Florida, New Ashford, North Adams, Savoy, Williamstown, and Windsor. The Mohawk Trail Woodlands Partnership study area has farms and homes scattered along rural roads, while forests carpet the hilltops. A proposed partnership with the state and U.S. Forest Service could lead to a new model for resilient forests that reduce the threats of fire, flood and damage to infrastructure while providing the co-benefits of conservation and economic development that leaves land in private ownership. In addition, this partnership would benefit forest-based economic development, including recreational tourism, local sustainable forest products, and research on new forest-related manufacturing technologies in a region where there are few opportunities to create new jobs. In addition, there is no natural gas; all municipal buildings are heated with heating oil or propane. Promoting the selective removal of trees through forestry and utilizing wood pellets as heating fuel will decrease costly damage to infrastructure and loss of service from that infrastructure from fallen trees and will increase forest vitality and sustainability. This will also provide the co-benefits of providing income to financially-strapped landowners, creating harvesting, trucking and manufacturing jobs, and providing renewable heating to the towns as an alternative to paying for expensive unregulated fossil fuels to heat schools, town halls, libraries, senior centers, public safety buildings, and DPW garages. This project will provide the additional co-benefit of incentivizing entrepreneurial removal and transport to the pellet plant of fallen trees and debris after a storm, offering savings

to municipalities and FEMA who otherwise would be paying for this service. The improvement harvests will create habitat for declining bird species. EEA and its agencies have recently received two USDA Natural Resource and Conservation Service grants totaling \$1.5 million to implement improvement harvests to benefit declining bird species and improve habitat for hunting, fishing and wildlife viewing to bolster the local economy in this region.

DOER has allocated funds of \$350,000 to: i. assess the forest resource base by collecting available forest inventory data through a typical resource analysis and estimate the current carbon balance in the area, incorporating USDA Forest Service Continuous Forest Inventory (CFI) data and MA DCR Forest Cutting Plans data for the region; ii. conduct surveys and meetings with landowners, foresters, timber harvesters and others to receive feedback on a plan to manufacture wood pellets in the area; iii. meet with local officials and survey local residents to assess the potential demand for heating publically-owned buildings and private residences with pellets including estimating both the local interest and the tons of pellets needed to meet local needs; iv. develop an estimate of potential energy dollars that would be saved on an annual basis; v. calculate the gallons of heating oil and propane that could be displaced by using wood pellets to heat municipal buildings and use the result to calculate estimated greenhouse gas emission reductions from thermal energy use, and the carbon balance in the forest; and vi. design a business plan for a wood pellet plant including assessment of markets and plant locations and the potential for a community-owned plant.

We are seeking HUD funds to help support the second phase of this initiative which will be dependent of the outcomes from the initial exploratory phase. MA is committing up to \$2 million to support a community-based wood pellet manufacturing facility and wood pellet distribution infrastructure and up to \$3 million for a competitive solicitation for municipalities to

propose feasibility studies, engineering design and construction grants to convert publically owned buildings from fossil fuel heating to renewable and sustainable wood pellet heating. We will create a blueprint for a business plan for the manufacturing of pellets in the region. The vision is not to manufacture wood pellets as a commodity item to be placed in the worldwide marketplace but rather a community sized manufacturing facility with the bulk of the production output targeted to meet local needs. The pellet plant feasibility study will look at a co-op model where several towns own the plant to help create a sustainable tax base.

This project is replicable by other rural, low income and heavily forested regions across the Northeast where downed trees from wind storms and flooding, and forest fires threaten rural areas. The HUD funding is essential to demonstrate this innovative project can be implemented in many other regions. For example, after Hurricane Sandy, there were both gasoline and fuel oil distribution disruptions in New York. Temperatures dropped soon after the storm passed and there were concerns that distribution disruptions could affect Northeast residents who rely on oil to heat their homes. Buildings with wood pellet boilers would not have been at such great risk of losing their heat and hot water after the large storm.

Tie Back: Trees downed during Tropical Storm Irene caused downed power lines and loss of electricity and damage to roads and sidewalks, and directed flood waters and sediments overland to downstream cities. By being able to harvest vulnerable trees we will minimize the effects from damage to property from falling trees. This area is extremely dependent on heating oil trucked in from various ports in the northeast. The local energy production and distribution will offset major roadway disruptions, including impeded access of fuel oil delivery trucks, caused from flooding and washouts. This will provide uninterrupted local heat to residents.

Unmet Need/National Objective: The region has hundreds of miles of isolated rural roads with dozens of stream crossings. This infrastructure is vulnerable to damage from falling trees during catastrophic storms. This project will create three regionally-scaled wood plants that will create steady high-value markets for high technology, forest thinning products. This will result in widespread forest improvement thinnings that will greatly reduce the risk to road and culvert infrastructure while creating good-paying, local jobs, increased tax base to cash-strapped small towns and a market that will fund storm clean up of downed trees. Our target areas are based on LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: Forests make up 80+% of this 20-town region. Due to poor past forestry practices and due to lack of markets for low quality products, the forest is aging with a high percentage of poor quality trees that are vulnerable to extensive storm damage from future hurricanes. The Harvard University Forest has modeled the response of the region's forests to a hurricane on the scale of the one that devastated Western Massachusetts in 1938. This model shows that the present forest (which is taller and older than that of 1938) will suffer major blowdown and increased flooding for several years after the storm and will be followed by increased forest fire threat after the downed material dries. According to foresters at Harvard University, a key strategy for the state to adapt to climate change would be to optimize our forest's ability to absorb more carbon, help maintain and regulate water quality, and prevent loss of forested area by engaging in active forest management to help find elevated uses for forest products. This project will create forest product markets for low quality trees, which will significantly expand treatments to upland forests to increase resilience to hurricanes and reduce damage to upland roads and culverts, increase infiltration in forest areas, and prevent conversion

of this precious natural resource to development. This would help preserve the forests for decades and prevent them from being converted to other land uses, which will prevent increases in impervious surfaces and associated stormwater runoff that can contribute to flooding.

Vulnerable Populations: In central and western Massachusetts, larger wood pellet renewable thermal systems connect to DOER's efforts to provide a local and sustainable market for pellets. This project will create 35 direct and 150 indirect jobs and reduce heating bills for municipal schools, public buildings and local residences by 50% in 40 public buildings and 500 private buildings. The project will be a model of local economic development based on a local, sustainable natural resource. The wood plants and associated harvesting and trucking jobs will be in the low income region. The funding that DOER is providing to this project requires wood products to be sourced and used locally. The project will also include a training and technical assistance component for local municipalities, residences and businesses.

Metrics: *Resiliency value* – reduced storm infrastructure damage and heat disruption versus other similar rural and heavily forested regions such as Southern Vermont; reduction in loss of trees and property damage; *Environmental value* – increase habitat diversity and forest health as measured by U.S. Forest Service periodic measurement of Forest Inventory and Assessment permanent forest plots and satellite imagery; improved water quality - reduced stormwater runoff; *Social value* – reduced heating cost for municipalities (schools and public buildings) and residences; benefits LMIs in target area; also benefits the entire region which is economically depressed; *Economic revitalization* – new jobs in three new high technology wood plants; the wood nanotechnology plant will ultimately create 10-15 direct and 35-55 indirect jobs plus 15 one-year construction jobs (blue collar manufacturing jobs except for 3-4 engineering jobs); the

CLT plant will ultimately create 10-15 direct and 75-100 indirect manufacturing jobs and the wood pellet plant will create 10-15 direct and 15-25 indirect jobs.

Periodic Evaluation: EEA and DOER will be evaluating the progress of the project.

Feasibility: The plan lays out a framework for economic development based on forest improvement harvesting to support local jobs. DOER has already launched a five-phased assessment to determine local supplies of wood, marketing and demand for wood pellets and assessment of furnace needs for public and private sectors, a business plan for the plant and siting locations for the plant. The National Science Foundation just awarded a grant (\$390,000) to the UMass Amherst Wood Building Technology Department to study local tree species from an engineering and building assessment perspective for use in Cross Laminated Timber technology – an emerging technology that has build scores of large wood buildings throughout the world in the past decade. The UMass Department just broke the ground of a new \$50 million academic building that will be made of CLT structural wood technology (the largest new wood structure in the region). The Endowment for Forestry and Communities (The Endowment) and the US Forest Service are committing \$1 million to assisting with the feasibility and design for wood nanotechnology, and pellet plants. These three plants will create approximately 185 permanent, good-paying jobs in impacted, low income towns. The wood nanotechnology plant will be part of a study/engineering design project that is already underway by The Endowment for Forestry and Communities for a small, heavily forested community in Northern California working with private industry and universities. This project will build on this work by choosing from the six process designs for wood nanotechnology currently underway by private firms and universities. The three wood plants in this project will support extensive improvement harvests across the region's forests to reduce road and culvert damage, reduce fire and flood threat and

increase forest resiliency to future catastrophic storms. The wood pellet plant feasibility study will look at a multiple town ownership model to support the critical tax base problem all these communities have. Local markets and sustainable forest growth will support the project into the long-range future plans for storm resiliency and economic growth and jobs.

Consultation: The project benefits from 30 public meetings over the last two years including several additional advisory committee meetings (with designees from the 20 towns and representatives of regional economic development, environmental organizations, a U.S. Forest Service Liaison). Through this outreach, a comprehensive plan was completed, with each chapter reviewed and approved by a local advisory committee composed of locally appointed members from the towns and economic development and environmental organizations. The Mohawk Trail Woodlands Partnership has also received three new federal grants since MA's Phase 1 NDRC application – two USDA NRCS grants (\$700,000 and \$837,000) to provide incentives to private forest owners to implement improvement harvests especially to provide habitat for at-risk wildlife species and one USDA Forest Service grant (\$250,000) to create a “Wood Heat Team” for the region to provide technical assistance in implementing wood heat technology in public and private buildings. These three grants will support this project by increasing the interest among private landowners to implement improvement harvests and the interest among municipalities and residents to implement wood heat. Also announced, since the Phase 1 NDRC application was submitted, is the funding from DOER to install wood furnaces in two elementary schools in the impacted low income towns (Charlemont and Heath).

Scoping/Scaling

Schedule and Budget: The HUD funding request is \$6.74 million and funding from other sources is \$5.35 million. Project will take 5 years to complete

Project 6. Reliable Electricity and Heat for Low Income Populations

Lead: DOER and DCHD

Project Description: This project consists of three programs, and an outreach element. The programs are the Renewable Energy for Low Income (RELI) Program; the SAPHIRE Program for Schools, Public Housing and Municipal Buildings; and the Community Clean Energy Resiliency Program for single or multiple municipalities, Regional Planning Agencies, regional districts (water, school, sewer, etc), partnerships with municipalities, and low income housing.

(i) The newly proposed **RELI Program**, to be launched in 2016, will help increase access to renewable energy technologies for low income residents. It has multiple grants and incentives, some open to organizations statewide and others targeted to specific communities. Two can benefit from HUD funds to complete resiliency projects in the Target Areas. The first feature of the RELI Program for which we are requesting support from HUD is the Multifamily Owner's Agent Grants, focused on providing owner's agent services to nonprofit affordable housing developers. Developers will be given assistance in identifying the best path to solar and the best renewable thermal technologies for their properties. The Owner's Agent will also be knowledgeable in building technologies, energy efficiency, and resiliency. All of the HUD funding will be spent in Target Areas while the DOER funding will be spend elsewhere, throughout the state. Although the majority of the DOER funding will be focused on the Owner's Agent's services, there will also be limited capital funding to offset some technology costs, such as solar or renewable thermal technology purchase. Renewable thermal technology can include high-efficiency cold climate air source heat pumps, ground source heat pumps, and wood pellet boilers. We are seeking HUD funding directed to the Target Areas to allow the Owner's Agent to provide additional services for resiliency and capital funding towards

resiliency projects. This would help leverage state funding and ensure that the reach of this statewide program to low income populations is maximized. Adding resiliency technologies to multifamily housing will allow critical facilities that often house the elderly, disabled, or otherwise vulnerable populations to remain operational during the event of a power outage. The second RELI program for which we are requesting funding is a community shared solar (CSS) demonstration project for design and implementation of a community shared solar project that provides cost savings to the low income community. Community shared solar is a new solar project design that can include the addition of storage technology to a CSS array and further benefit the LMI community. This program would benefit any non-profit affordable housing in these towns or any planned developments. The CSS project could be hosted on a number of buildings in each community, as long as the owner was interested in and the building was physically capable of being the CSS system host. The addition of storage would allow the host building to remain powered in the event of a power outage during a storm or disaster like Tropical Storm Irene. We also propose to use HUD funding to provide multi-family owners and CSS arrays with a battery backup to increase resiliency of Target Areas during a natural disaster.

(ii) The SAPHIRE Program supports feasibility studies and technology installation of renewable thermal projects. These funds support both the state-sponsored affordable housing developments that are managed by the local housing authorities and public schools. Additional funding from HUD for those local housing authorities and schools will be used to increase capital funding to purchase additional resiliency technology, such as solar-and-storage systems for Target Areas. This program began in 2012 with support for Department of Energy (DOE) and has been successful at providing energy feasibility studies and technology to MA housing and schools. Similar to the RELI Multifamily Owners' Agent Program, additional funding from

HUD to the SAPHIRE Program will provide capital funding to combine resiliency technology with the provided renewable and feasibility funding for critical facilities in the Target Area communities, such as all the public school and state-sponsored affordable housing.

(iii) Community Clean Energy Resiliency Program will support critical facilities including buildings or structures where loss of electrical service would result in disruption of a critical public safety life sustaining function. Eligible clean energy technologies include: clean energy generation, energy storage, energy management systems, technology used for DG operation in island mode, and single building facilities or microgrids. Projects must meet the following criteria: use eligible clean energy technologies; be sited at eligible critical facilities; demonstrate strategic electric isolation of critical loads from non-critical building loads to effectively extend resiliency capability; be able to operate in parallel with the grid during “blue sky” days and island and operate in isolation from the grid during a broader grid outage; meet utility interconnection strategy guidelines; and follow the Initiative funding guidelines. Projects may be retrofitted or newly installed. Funding will cover the following costs: system design and engineering costs; clean energy generation (electric and thermal) and storage costs that are not covered by other incentives; clean energy equipment that provides for resiliency; interconnection costs related to resiliency equipment; installation costs; administrative costs (not to exceed 5% of total costs); and other costs as deemed appropriate by DOER.

iv. Community Outreach and Technical Assistance: The MA Team will work with regional partners such as the Franklin County Regional Housing and Redevelopment Authority, Community Action, and Franklin County Home Care, to implement an outreach program targeted at multi-family home owners, Owner’s Agents, schools, state-sponsored affordable housing developments, and non-profit housing agencies that serve low and moderate income

persons in the Target Areas, including seniors. These organizations currently provide a variety of service to low and moderate income populations and our partnership will help to ensure the success of this activity. Additional services will also be provided through the Green Communities division of the DOER which maintains regional coordinators that engage local partners in each region of MA. This ensures all energy opportunities that DOER provides are clearly communicated throughout the Commonwealth. Technical assistance grants will be offered at no cost to applicants interested in the Community Clean Energy Resiliency Program. Those applicants receiving award will have the opportunity to use the resulting plan to apply for a project implementation funding.

Budget and Schedule: \$2 million, Fall 2017 to Fall 2019

Tie Back: Storms like Tropical Storm Irene seriously impacted the energy utility infrastructure causing many to lose power for days (Exhibit D).

Unmet Need/National Objective: This project directly addresses the unmet need in target areas of having reliable energy resiliency. Our target areas are based on LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons. Also, low income families will benefit from lower energy cost.

Current/Future Risks: The addition of renewable energy technologies to both multi-family low income housing and public schools greatly increases their physical and financial resiliency. The programs incentivize renewable energy technologies which can be paired with battery technology, at an added cost, to preserve building operation and critical functions during a power outage. The installation of a high efficiency cold-climate air source heat pumps paired with storage technology can provide efficient heating and cooling during these periods of outage. The community shared solar project will support innovated designs that can include the

addition of storage to increase community resiliency. Low cost renewable energy technologies will also help with low income residents' and organizations' financial stability, producing free electricity and using lower-cost heating fuel.

Vulnerable Populations: Multi-family complexes can act as critical facilities, especially for the elderly and disabled. Often, these residents cannot easily relocate during an extended power outage. Those with health issues will also benefit from continued heating and cooling which will be provided through these renewable thermal technologies. Schools can act as shelters for the community during disasters. Part of DOER's mission in promoting renewable technologies is the promotion of the workforce associated with that industry. Both of these programs fund renewable thermal systems that rely on local installation and maintenance.

Metrics: *Resilience Value* - Reduced vulnerability of energy infrastructure to power outages; *Environmental Value* - Reduced energy use; reduced greenhouse gas emissions; *Social Value* - Directly benefit LMI people; greater affordability of renewable energy; *Economic Revitalization* - Affects local economy by creating new jobs.

Periodic Evaluation: The program will be evaluated through the use of energy-use monitoring software, which may include WegoWise for electricity and fuel usage. This monitoring will allow DOER to ensure that the technologies are operating correctly.

Feasibility: The Program integrates technical assistance and feasibility studies. In order to foster continued market growth in these sectors, the feasibility studies will be conducted as part of the Owner's Agent service, and provided publically. This allows other communities to research and learn about how these technologies may benefit their critical facilities. Energy use is monitored to ensure DOER can communicate to other communities the best available energy behaviors. This program is feasible because program design is based on either previously successful DOER

programs or competitive selection that judges project design and defines incentive amounts.

DOER has previously provided technical assistance grant funding through the Green Communities programs which were successful and received positively. The SAPHIRE Program is currently operating successfully. DOER has considerable experience funding multiple resiliency projects across the Commonwealth through the Community Clean Energy Resiliency Initiative and is confident that the experience will enable it to successfully add resiliency services into its renewable programs.

Consultation: The RELI multi-family program was developed to address a need in the multi-family sector expressed by many local affordable housing organizations, including Preservation of Affordable Housing, Local Initiatives Support Corporation, New Ecology, Boston Community Capital, Action for Boston Community Development, and the Low Income Energy Affordability Network. Many organizations expressed a need in the non-profit sector. The multi-family program aids these smaller non-profit developers to receive needed technical assistance as many of these groups do not have the in-house staff or expertise to design complicated projects.

Scoping/Scaling: This is a statewide program that will impact a small subset of the population. With HUD funding, direct assistance can focus on this application's Target Areas. A scaling back of the project will result in fewer public schools, multifamily homes and affordable housing facilities getting assistance with renewable and efficient energy, however the project could be scaled up or down.

III. Springfield - Recovery and Resilience in a Gateway City

Across MA, state government agencies are making a coordinated effort to focus policies and programs on enhancing Gateway Cities, including Springfield, which were defined in 2010 legislation as having a population greater than 35,000, and median annual household incomes and educational attainment levels below the state average. The 26 cities meeting this definition are largely older mill cities that have experienced disinvestment, but in which a substantial portion of the state population lives or works. Recognizing the fiscal, social, and environmental benefits of revitalizing these communities programs at EOHE, EEA, and other agencies have been developed and others modified specifically to encourage growth and enhance quality of life in these cities. Examples include: i) The Gateway City Parks Program that has invested nearly \$60 million to create or restore parks in underserved urban neighborhoods; ii) MassDevelopment's Transformative Development Initiative, a redevelopment program for Gateway Cities designed to enhance local public-private engagement and community identity; stimulate an improved quality of life for local residents; and spur increased investment and economic activity; and iii) The Housing Development Incentive Program that provides Gateway Cities with two tax incentive tools to increase residential growth, expand diversity of housing stock, support economic development, and promote neighborhood stabilization.

The June 1, 2011 tornadoes de-vegetated a large swath of Springfield, and the snowstorms decimated additional vegetation. Almost 10,000 acres of woodlands were destroyed in the storm's path including 7,500 mature trees in Springfield; 30% of its trees were lost during the tornadoes. Street-side tree canopy cover was stripped to 1% in the East Forest Park area of the city. The loss of trees has increased stormwater runoff and flooding, increased temperatures, and increased demand for heating and cooling under climate change (Exhibits B and D). Springfield also has unmet recovery needs of 255 residential structures and 615 residential units

that were damaged by the tornadoes. The devastating effects of the tornadoes compounded years of urban sprawl and disinvestment, worsening the city's blighted areas. The city needs to minimize blight through activities that infilling development, expanding green space, and building community gardens. Springfield's infrastructure was significantly affected by the tornadoes and by the October 29-30 2011 snowstorm. Finally, there was considerable damage to roads, sidewalks, drainage systems, and other public infrastructure from trees and debris. Van Horn Dam and Watershops Pond were also damaged during the disasters (Exhibits B and D).

Project 7. Connecticut River WWTP and CSO Resiliency

Lead: Springfield Water and Sewer Commission, City of Springfield, AECOM, DEP

The second largest treatment facility in New England, the Springfield Wastewater Treatment Plant is designed to treat 67 million gallons per day. A regional plant, 85-90% of its inflow comes from Springfield; effluent from the plant discharges to the Connecticut River. Springfield has a combined sewer system with overflows that impact the Connecticut River and seven aging pump stations which are located in the river's floodplain. Hurricane Irene resulted in the flooding of the Greenfield Wastewater Treatment Plant, which experienced a subsequent electrical failure and discharged raw sewage to the Connecticut River, affecting Massachusetts, Connecticut and Long Island Sound. Such a failure could also occur in Springfield where there are seven Flood Control Pump Stations, all constructed as a result of the 1936 flood and subsequent U.S. Army Corps funding. Most equipment and electrical systems are original to the stations and are 70-75 years old, are located in the river's floodplain, and have not been flood-proofed. In the event of a hurricane or large storm event with substantial flooding, these pump storage stations and other elements of the wastewater system could be flooded and fail, resulting in the discharge of large volumes of untreated combined sewage overflows to the Connecticut River. In addition, heavy

rainfalls associated with Hurricane Irene and other large storms cause the combined sewer overflows to activate, resulting in the discharge of a combination of stormwater and raw wastewater to the Connecticut River. With increased impervious surface compared to when the system was designed and increased intensity of rainfall associated with climate change, the combined system needs to be more resilient.

7.1 Pump Station Floodproofing. This activity will involve the permitting, design, construction, and installation of equipment and systems that would contribute to the hardening of five of Springfield's flood control systems and will provide significant operational advantages over the existing equipment. Those five systems are: York Street Pumping Station, Union Street Pumping Station, Phelps Street Pumping Station, Clinton Street Pumping Station, and Avocado Street Pumping Station. The MA Team and the city have coordinated on this request: Springfield has included a request for funding for the other two systems in its Phase 2 NDRC application.

Budget: \$2,000,000

7.2 Separation of Combined System at I-91. There are a series of locations along Interstate 91 and Interstate 291, where large volumes of stormwater discharges into the combined sewer system in Springfield, contributing to the frequency and volume of CSOs. Locations include: a) I-91, to Norwood Street CSO, East Columbus CSO #16, and West Columbus St. (2 acres); b) I-291, lower I-291 discharge to CSO #10, at Dwight Street and Chestnut Street (17 acres); c) I-291, upper I-291 discharge to Albany St. CSO #13 (21 acres); d) I-91 at Clinton Street, discharge to CSO #10 (1.4 acres); and I-91 to York St. CSO #16 (2.5 acres). The proposed project would design and construct stormwater retention/ recharge systems to eliminate Interstate highway stormwater discharges to CSO system. There is a detailed inventory of sites along I-91 and I-291 where stormwater remediation is needed (memo from MWH consultants). Total inflow

from MDOT sites to Springfield CSOs is estimated at 21.9 mgd. NDRC grant funds are proposed for design, engineering and construction of stormwater best management practices (BMPs) to retain and recharge stormwater on-site in the above identified locations. An estimate of needed cost for BMP design and construction would be \$30,000 to \$50,000 per site.

Budget: \$2,000,000

7.3 Connecticut River Combined Sewer Crossing and Pump Station. This project is to fund the design of a larger river crossing pipe from Springfield to the regional wastewater treatment plant to compensate for substantial changes in pervious areas tributary to the Springfield Regional Wastewater Treatment Facility. These changes have had a significant impact on the amount stormwater entering the combined system as well as the timing of how the system can react to the increased flow regime. Additionally, documented changes in weather patterns have resulted in more frequent high intensity short duration rain events. These events in particular create public health and safety problems, as well as regulatory compliance issues. The project itself will provide increased capacity to accommodate the changes in flow regime in the form of a new river crossing and pump station. The project will also provide redundancy to system which has been in service for more than 75 years of continuous use and has no ability to come off service for maintenance and repair. The project will also provide for optimal use of the York Street Flood Control Pumping Station by allowing separation of pumping flood waters and sewage out of the system. Increased capacities will provide more flood control opportunities.

The proposed project is the result of a prioritized system wide assessment of wastewater system needs based upon risk and criticality of failure. The comprehensive program utilizes industry leading asset management principles on a computerized software platform. This project will reduce the wastewater system's highest risk assets. The programmatic approach to

prioritization is repeatable and applicable to all water and sewer systems. All CIP work comes from the comprehensive evaluation protocols established as part of this program. The proposed project will also provide the design of a system that will provide a significant reduction in the number and volume of Combined Sewer Overflows (CSO) to the Connecticut River. CSOs are a highly regulated discharge of combined sewage (rain water and sewage) into waters of the United States. The proposed project would reduce overflow to the Connecticut River by tens of millions of gallons per year.

Budget: \$5,000,000

7.4 Dickinson Siphon/Main Interceptor Rehabilitation. The overall objective of the project is to rehabilitate and extend the lifespan of existing infrastructure and to improve hydraulic capacity which allows for mitigation of structural failure leading to SSO events. Approximately half the City of Springfield and the surrounding towns of Ludlow and Wilbraham are served by the Main Interceptor (MI) which runs for approximately 27,200 feet. The MI was built in 1972 and is constructed of 60-in and 66-in Reinforced Concrete Pipe (RCP). Based on recent inspection, the MI is considered to be in structural distress. The Dickinson Street Siphon feeds a large catchment of flow into the MI. SSOs into the Mill River and neighborhoods have occurred at the siphon during heavy rainfall events. As part of the project, the siphon will be replaced with a large diameter gravity sewer.

Budget: \$8,022,000.00 (leverage from DEP)

Tie Back: This project will address flooding within Springfield and provide for a more resiliency to prevent future flooding as a result of climate change and future disasters. With ageing infrastructure, this project will help to modernize the flood control system to be able to withstand heavy rain events. The proposed project will allow for inclusion of design principles that address

the changes in pervious land and account for the short duration high intensity storms that are more frequently occurring. The use of hydraulic modeling allows for analysis of a variety of scenarios, including actual storm data to interpret responsiveness of proposed system changes and how a specific storm impacts different wastewater facilities. This tool allows for optimization of selected projects.

Unmet Need/National Objective: This implementation project will directly help our Target Area meet its unmet recovery need to prevent inundation of wastewater treatment plants. Being able to pump wastewater effectively during periods of high flow from rainfall will help to protect against additional activations of combined sewer overflows. This protects against potential public health and water quality effects that would occur with the failure of Springfield's wastewater infrastructure. The Springfield Target Area is entirely LMI, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: This project will provide Springfield needed floodproofing to withstand high flows that are typical of a changing climate, and to prevent the release of raw sewage to waterways. Climate change is already causing a shift in precipitation, with more extreme events, and larger high intensity rainfall over a short period. While this Springfield WWTP and its facilities were spared during Tropical Storm Irene, flooding impacts to other WWTPs in the Connecticut Valley shows what happens when such a facility is inundated for multiple days and results in raw sewage directly entering the river! These retrofits will help one of the largest cities in MA to endure these conditions. Project design will account for changes in storm profiles and frequency. New design standards will allow for modeling of actual storms vs. synthetic storms. This will allow for designers to properly reflect the duration and intensities of storms that have occurred.

Vulnerable Populations: 65.71% of the residents of the Springfield Target Area are at less than 80% of the area median income (AMI). The entire population of Springfield, including its most vulnerable populations, will benefit from the protection of improved resiliency at the five pump stations. With 29.4% of the population living below the poverty level, they will also benefit from the avoided costs of having to pay for these improvements. This project will impact the entire down town of Springfield and will provide meaningful stormwater, wastewater, and flooding benefits to multiple hospitals, schools, critical government offices, and flood control facilities.

Metrics: *Resilience Value* - Reduced vulnerability to water infrastructure - reduction in plant failures; prevention of flooding at plant; *Environmental Value* - Decreased contamination in waterways; decrease in back-ups; *Social Value* - Reduction in human suffering; diminished public health threat; direct benefit to vulnerable LMIs; *Economic Revitalization* - Directly affects local economy; failure at plants can impact all individuals and businesses.

Periodic Evaluation: EEA and its agency with wastewater-related responsibilities, the DEP, will evaluate the progress of this project throughout its implementation.

Feasibility: This project is considered highly feasible. We fully expect the retrofits to be complete within the specified timeline. Initial studies have already been completed and the project is the result of a robust screening program which looks at a variety of alternatives and addresses such impacts as environmental, social & community, sensitive populations, community disruption, cost benefit, regulatory compliance, feasibility, and others.

Consultation: The MA Team coordinated with the city of Springfield, the Springfield Water and Sewer Commission, and the Pioneer Valley Planning Commission (PVPC) in the development of this project. PVPC's HUD-funded multi-year stakeholder process that resulted in a Climate

Action and Clean Energy Plan released in 2014 highlighted this project as their top action for wastewater issues.

Scoping/Scaling: The list of retrofits can be prioritized and if the project budget is scaled back then implementation can occur at the top priority sites. The project can be scaled up or down by use of modeling various alternatives. Within each alternative different specific capacities are evaluated to optimize all aspects of the project

Schedule and Budget: We are requesting \$2 million from HUD to floodproof the five pump stations, \$2 million to stormwater draining from I-91 and I-291 to the combined sewer system and \$5 million for design of the Connecticut River Combined Sewer Crossing and Pump Station. As leverage, we are providing \$8,022,000 for the Dickinson Siphon/Main Interceptor Rehabilitation. Project will take 2-4 years to complete

Project 8. Climate Resilient Green Infrastructure for Flood Control

We will implement green infrastructure by constructing or creating natural green spaces that provide multiple benefits such as recharge and flood control, improvements to water quality, replenish groundwater, provide key habitats, increase recreational value, and provide aesthetically pleasing more livable and friendly spaces typically not seen in low and moderate income areas and downtown centers. Green infrastructure helps promote restoration and protection of natural floodplains as a natural defense against floodwaters rather than walls, dikes, and hard barriers. It can be anything from constructed wetlands, trees, conserved areas, tree box filters, pervious pavement, grassed swales, riparian buffers, rain gardens, green roofs, and bio-retention areas.

8.1 Prioritization of Green Infrastructure using a Heat and Flood Map

Lead: TPL, City of Springfield, PVPC

The city's proximity to the river, its high percentage of impervious area, and its past development patterns have led to increased vulnerability to flooding, which is exacerbated during high burst rainfall events. Mitigating this impact by creating natural areas which facilitate recharge while providing other co-benefits is particularly important. In partnership with The Trust for Public Land (TPL), through their Climate-Smart Cities™ program, we propose to prioritize locations and implementation of green infrastructure in the city through the development of a tool that is targeted at resilience building, vulnerable communities, and carbon mitigation and uses climate scenario data to inform the user where to deploy wetlands, "water smart" parks and playgrounds, green alleys, and other permeable surfaces to absorb water and recharge local aquifers, curb storm water runoff pollution and inundation, and reduce energy used for water treatment and conveyance of public water supplies. The tool can also be used to help planners create strategically-sited waterfront parks and living buffers to protect cities from river-borne flooding, and other related inundation threats. Co-benefits of this tool are that it helps cities to combat the effects of urban heat island by fashioning specially designed urban green spaces, highly reflective surfaces, and strategically-sited shade trees to lessen the energy use and human health impacts resulting from the urban heat island effect. Another co-benefit is that the tool can help to connect areas within the city and region through walk-bike corridors and public transit and provides potential mode shift toward carbon-free and resilient transportation options.

The Climate-Smart Cities™ program pursues multiple-benefit green infrastructure opportunities wherever possible through the application of science, spatial decision support, and project design expertise to find neighborhoods and sites where these multiple-benefits can be realized through a single strategic investment. The program also integrates climate justice by

applying social, demographic, and health analyses as an overlay to the “connect, cool, absorb, protect” framework, ensuring that vulnerable populations are prioritized for green infrastructure investments and policies. For example, using spatial data to understand which urban neighborhoods have a high level of seniors, strong urban heat island, and low urban tree canopy can help prioritize “cool”-related green infrastructure since seniors are much more likely to suffer health impacts during summer heat waves.

Periodic Evaluation: The GIS-based decision support tools provide the ability to evaluate the work against these metrics — all the way to the parcel level. This capacity is the result of custom Javascript coding developed by TPL that will enable us to tag parcels and block groups with detailed data attributes, and will allow users to query those attributes and report on them quickly and accurately. In addition to this evaluation capacity at the project and neighborhood level, TPL has also developed a “Measures of Progress” tool to compile city-scale statistics of project accomplishments against these metrics cumulatively over the multi-decadal implementation cycle that is ultimately envisioned for each of its city and metro-scale efforts. Through this tool, The MA Team will help to raise the capacity of decision-makers and community members in Springfield regarding the value of multi-benefit green infrastructure to increase the resilience of their community. Major activities are:

1. *Partnership development and community engagement:* conduct outreach to local leaders and organizations such as PVPC, and conduct outreach to neighborhood organizations and civic leaders.
2. *Identify research needs and/or data gaps:* scope potential data gaps and research needs and consider application of TPL’s existing research partners, such as Georgia Tech or Arizona State University.

3. *GIS Decision Support Tool Development*: establish a Technical Advisory Team comprised of municipal leaders, staff, and stakeholders to advise TPL in identifying criteria, data and interpretation of the data; model priorities for each goal (Absorb, Protect, Cool, and Connect, Cool), and; develop a web-based tool to host model results and provide information down to the parcel level.

4. *Training and Community Engagement*: conduct trainings for partners at the city and other civic leaders; develop a public facing Story map to communicate results to the public.

5. *Identification and Feasibility Assessment of Green Infrastructure Projects*: working in partnership with the City and others, use the decision support tool to identify potential green infrastructure intervention opportunities for a multi-benefit targeted investment; work with Springfield and partners such as PVPC to identify potential climate policy and funding opportunities such as the Community Preservation Act for resiliency with green infrastructure; identify new green infrastructure projects and work with the City to begin implementation.

Feasibility: The foundation of the Climate-Smart Cities™ program is to anchor climate-smart urban greening in scientific principles and data. All the urban greening is rooted in quantifiable metrics such as, urban heat mapping and modeling with Georgia Tech, flood-related mapping with Drexel and Columbia, and globally-unique carbon emissions data from Arizona State University's Hestia Project. These structural considerations for green infrastructure development are correlated with spatial data on social and demographic vulnerability indicators. Our project evaluation nationally examines how effectively we have merged the intersection of carbon/vulnerability metrics with these human factors. This approach is currently being implementing with cities like New York City, Los Angeles, King County (WA), and Chattanooga, Boston and the Metro Mayors Coalition (which includes the 13 cities and town

surrounding Boston). Each program uses the same synthesis of applied research through university partners, online GIS decision support, and green infrastructure intervention projects.

Schedule and Budget: The total cost for these activities is \$275,000, including funds to support engagement from local partners.

8.2. Green Infrastructure Implementation

LEAD: EEA, City of Springfield

Partner: PVPC, DER

We will install and implement green infrastructure in prioritized locations identified in 8.1.

Springfield, the third largest city in the Commonwealth has a significant amount of impervious surfaces, especially in the low income areas located in the western part of the city, right adjacent to the Connecticut River. The topography and hydrology of the area is such that stormwater after a rain event runs over these surfaces collecting pollutants, oil residues, fertilizer, trash and other chemicals, and floods sections of the city before ultimately meeting the Connecticut River. Not only is property damaged, and people inconvenienced, but water quality is impacted. This project will take the results of the TPL effort described above and work with the City and other local stakeholders on implementation of green infrastructure, and as necessary, prepare designs, obtain environmental permits, and install or construct green infrastructure features.

Budget: Request from HUD is \$4,000,000

8.3. Climate Resilient Grey Infrastructure for Flood Control

LEAD: EEA, Springfield

Partner: PVPC, DER

Similar to the Deerfield watershed, severe storms have washed out culverts, and destabilized dams and levees in the Springfield area. These events also highlighted the inadequacy of these and other structures such as flood gates at keeping water away. Much of the grey infrastructure in Springfield is several decades old and was designed using outdated precipitation data (the U.S.

Department of Commerce's Technical Paper-40 or TP-40), and a 100-year storm calculation that has since changed. The result is that today, the infrastructure is either undersized or in poor and deteriorating condition put them at even higher risk for failure during future storm events.

According to the PVPC [Climate Action and Clean Energy Plan](#) there are 2885 culverts in Hampden and Hampshire counties, 146 of which are in Springfield, while 15 dams are in poor or unsafe condition and classified as either high or significant hazards, 5 of which are in Springfield. There is a strong need to resize the culverts and bring them in line with the Massachusetts stream crossing standards.

Budget: Our request from HUD is \$4,000,000.

Schedule:

For Projects 8.1 – 8.3:

Tie Back: These projects are all water related and will help the Springfield target area address its most significant climate impact – flooding. Flooding impacts can seriously hamper the functioning of its wastewater treatment plant, and also impacts the low and moderate income residents who live in a particularly vulnerable part of the city, close to the river. These projects will help make the plant more resilient, prevent future plant failures, identify areas in particular need for softer approaches, begin the process of installing green infrastructure, and address key grey infrastructure that is failing or undersized. All of these will help prepare for the next big storm and minimize or prevent damage from flooding and enable the city to better withstand heavy rain events.

Unmet Need/National Objective: These projects will directly help our target area meet its unmet recovery need as a result of impacts from the declared disasters. Our target areas are based on

LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons.

Current/Future Risks: This project will provide the city of Springfield the needed flood proofing to withstand high flows that are typical of a changing climate in Massachusetts, and to prevent the release of raw sewage to waterways. Climate change is already causing a shift in precipitation, with more extreme events, and larger high intensity rainfall over a short period. These retrofits will help one of the largest cities in the Commonwealth to endure these conditions.

Vulnerable Populations:

Metrics: *Resilience Value* - Reduced vulnerability to water infrastructure - reduction in plant failures; prevention of flooding at plant; *Environmental Value* - Decreased contamination in waterways; decrease in back-ups; *Social Value* - Reduction in human suffering-Diminished public health threat; direct benefit to vulnerable LMIs; *Economic Revitalization* - Directly affects local economy. Failure at plants can impact all individuals and businesses.

Periodic Evaluation: EEA, PVPC, and the City of Springfield will evaluate the progress of this project throughout its implementation.

Feasibility: This project is considered highly feasible. We fully expect the retrofits at the treatment plant to be complete within the specified timeline.

Consultation: The project was based on feedback from the Springfield public meeting, and developed in consultation with PVPC, the City of Springfield, TPL, and DPH.

Scoping/Scaling: If the project budget is scaled back then implementation can occur for fewer green infrastructure projects.

Overall Budget: is \$8,275,000 and the project will take 2-4 years.

Project 9. Reliable Electricity and Heat for Low Income Populations

Lead: DOER and DCHD

Project Description: This project consists of three programs, and an outreach element. The programs are the Renewable Energy for Low Income (RELI) Program; the SAPHIRE Program for Schools, Public Housing and Municipal Buildings; and the Community Clean Energy Resiliency Program for single or multiple municipalities, Regional Planning Agencies, regional districts (water, school, sewer, etc), partnerships with municipalities, and low income housing.

(i) The newly proposed **RELI Program**, to be launched in 2016, will help increase access to renewable energy technologies for low income residents. It has multiple grants and incentives, some open to organizations statewide and others targeted to specific communities. Two can benefit from HUD funds to complete resiliency projects in the Target Areas. The first feature of the RELI Program for which we are requesting support from HUD is the Multifamily Owner's Agent Grants, focused on providing owner's agent services to nonprofit affordable housing developers. Developers will be given assistance in identifying the best path to solar and the best renewable thermal technologies for their properties. The Owner's Agent will also be knowledgeable in building technologies, energy efficiency, and resiliency. All of the HUD funding will be spent in Target Areas while the DOER funding will be spend elsewhere, throughout the state. Although the majority of the DOER funding will be focused on the Owner's Agent's services, there will also be limited capital funding to offset some technology costs, such as solar or renewable thermal technology purchase. Renewable thermal technology can include high-efficiency cold climate air source heat pumps, ground source heat pumps, and wood pellet boilers. We are seeking HUD funding directed to the target areas to allow the

Owner's Agent to provide additional services for resiliency and capital funding towards resiliency projects. This would help leverage state funding and ensure that the reach of this statewide program to low income populations is maximized. Adding resiliency technologies to multifamily housing will allow critical facilities that often house the elderly, disabled, or otherwise vulnerable populations to remain operational during the event of a power outage. The second RELI program for which we are requesting funding is a community shared solar (CSS) demonstration project for design and implementation of a community shared solar project that provides cost savings to the low income community. Community shared solar is a new solar project design that can include the addition of storage technology to a CSS array and further benefit the LMI community. This program would benefit any non-profit affordable housing in these towns or any planned developments. The CSS project could be hosted on a number of buildings in each community, as long as the owner was interested in and the building was physically capable of being the CSS system host. The addition of storage would allow the host building to remain powered in the event of a power outage during a storm or disaster like Tropical Storm Irene. We also propose to use HUD funding to provide multi-family owners and CSS arrays with a battery backup to increase resiliency of Target Areas during a natural disaster.

(ii) The **SAPHIRE Program** supports feasibility studies and technology installation of renewable thermal projects. These funds support both the state-sponsored affordable housing developments that are managed by the local housing authorities and public schools. Additional funding from HUD for those local housing authorities and schools will be used to increase capital funding to purchase additional resiliency technology, such as solar-and-storage systems for Target Areas. This program began in 2012 with support for Department of Energy (DOE) and has been successful at providing energy feasibility studies and technology to MA housing

and schools. Similar to the RELI Multifamily Owners' Agent Program, additional funding from HUD to the SAPHIRE program will provide capital funding to combine resiliency technology with the provided renewable and feasibility funding for critical facilities in the Target Area communities, such as all the public school and state-sponsored affordable housing.

iii. Community Outreach: FRCOG will work with our regional partners at the Franklin County Regional Housing & Redevelopment Authority, Community Action, and Franklin County Home Care to implement an outreach program targeted at multi-family owners, Owner's Agents, schools, state-sponsored affordable housing developments, and non-profit housing agencies that serve low and moderate income persons in the Target Areas, including seniors. These organizations currently provide a variety of service to low and moderate income populations and our partnership will help to ensure the success of our RELI and SAPHIRE programs. Additional services will also be provided through the Green Communities division of the DOER which maintains regional coordinators that engage local partners in each region of MA. This ensures all energy opportunities that DOER provides are clearly communicated throughout the Commonwealth.

(iii) Community Clean Energy Resiliency Program will support critical facilities including buildings or structures where loss of electrical service would result in disruption of a critical public safety life sustaining function. Eligible clean energy technologies include: clean energy generation, energy storage, energy management systems, technology used for DG operation in island mode, and single building facilities or microgrids. Projects must meet the following criteria: use eligible clean energy technologies; be sited at eligible critical facilities; demonstrate strategic electric isolation of critical loads from non-critical building loads to effectively extend resiliency capability; be able to operate in parallel with the grid during "blue

sky” days and island and operate in isolation from the grid during a broader grid outage; meet utility interconnection strategy guidelines; and follow the Initiative funding guidelines. Projects may be retrofitted or newly installed. Funding will cover the following costs: system design and engineering costs; clean energy generation (electric and thermal) and storage costs that are not covered by other incentives; clean energy equipment that provides for resiliency; interconnection costs related to resiliency equipment; installation costs; administrative costs (not to exceed 5% of total costs); and other costs as deemed appropriate by DOER.

iv. Community Outreach and Technical Assistance: The MA Team will work with regional entities like PVPC to implement an outreach program targeted at multi-family home owners, Owner’s Agents, schools, state-sponsored affordable housing developments, and non-profit housing agencies that serve low and moderate income persons in the Target Areas, including seniors. These organizations currently provide a variety of service to low and moderate income populations and our partnership will help to ensure the success of this activity. The aim is to provide a variety of service to low and moderate income populations and our collaborations will help to ensure the success of our RELI, SAPHIRE, and energy efficiency programs. Additional services will also be provided through the Green Communities division of the DOER which maintains regional coordinators that engage local partners in each region of MA. This ensures all energy opportunities that DOER provides are clearly communicated throughout the Commonwealth. Technical assistance grants will be offered at no cost to applicants interested in the Community Clean Energy Resiliency Program. Those applicants receiving award will have the opportunity to use the resulting plan to apply for a project implementation funding.

Budget and Schedule: \$2 million, Fall 2017 to Fall 2019

Tie Back: Storms like Tropical Storm Irene seriously impacted the energy utility infrastructure causing many to lose power for days (Exhibit D).

Unmet Need/National Objective: This project directly addresses the unmet need in target areas of having reliable energy resiliency. Our target areas are based on LMIs, so this project meets the national objective of Benefit to Low and Moderate Income Persons. Also, low income families will benefit from lower energy cost.

Current/Future Risks: The addition of renewable energy technologies to both multi-family low income housing and public schools greatly increases their physical and financial resiliency. The programs incentivize renewable energy technologies which can be paired with battery technology, at an added cost, to preserve building operation and critical functions during a power outage. The installation of a high efficiency cold-climate air source heat pumps paired with storage technology can provide efficient heating and cooling during these periods of outage. The community shared solar project will support innovated designs that can include the addition of storage to increase community resiliency. Low cost renewable energy technologies will also help with low income residents' and organizations' financial stability, producing free electricity and using lower-cost heating fuel.

Vulnerable Populations: Multi-family complexes can act as critical facilities, especially for the elderly and disabled. Often, these residents cannot easily relocate during an extended power outage. Those with health issues will also benefit from continued heating and cooling which will be provided through these renewable thermal technologies. Schools can act as shelters for the community during disasters. Part of DOER's mission in promoting renewable technologies is the promotion of the workforce associated with that industry. Both of these programs fund renewable thermal systems that rely on local installation and maintenance.

Metrics Resilience Value - Reduced vulnerability of energy infrastructure to power outages;

Environmental Value - Reduced energy use; reduced greenhouse gas emissions; ***Social Value*** -

Directly benefit LMI people; greater affordability of renewable energy; ***Economic Revitalization***

- Affects local economy by creating new jobs.

Periodic Evaluation: The program will be evaluated through the use of energy-use monitoring software, which may include WegoWise for electricity and fuel usage. This monitoring will allow DOER to ensure that the technologies are operating correctly.

Feasibility: The Program integrates technical assistance and feasibility studies. In order to foster continued market growth in these sectors, the feasibility studies will be conducted as part of the Owner's Agent service, and provided publically. This allows other communities to research and learn about how these technologies may benefit their critical facilities. Energy use is monitored to ensure DOER can communicate to other communities the best available energy behaviors.

This program is feasible because program design is based on either previously successful DOER programs or competitive selection that judges project design and defines incentive amounts.

DOER has previously provided technical assistance grant funding through the Green Communities programs which were successful and received positively. The SAPHIRE Program is currently operating successfully. DOER has considerable experience funding multiple resiliency projects across the Commonwealth through the Community Clean Energy Resiliency Initiative and is confident that the experience will enable it to successfully add resiliency services into its renewable programs.

Consultation: The RELI multi-family program was developed to address a need in the multi-family sector expressed by many local affordable housing organizations, including Preservation of Affordable Housing, Local Initiatives Support Corporation, New Ecology, Boston

Community Capitol, Action for Boston Community Development, and the Low Income Energy Affordability Network. Many organizations expressed a need in the non-profit sector. The multi-family program aids these smaller non-profit developers to receive needed technical assistance as many of these groups do not have the in-house staff or expertise to design complicated projects.

Scoping/Scaling: This is a statewide program that will impact a small subset of the population. With HUD funding, direct assistance can focus on this application's Target Areas. A scaling back of the project will result in fewer public schools, multifamily homes and affordable housing facilities getting assistance with renewable and efficient energy, however the project could be scaled up or down.

Project 10. Regional Planning Collaborative for Resiliency and Implementation

LEAD: EEA, DPH and Regional Planning Agencies

Through a Regional Planning Collaborative, EEA and the Regional Planning Agencies (RPAs) will work together to share lessons learned from the NDRC projects as well as from Leverage Projects described in Exhibit F to build community capacity by developing implementation guidance and providing technical assistance to the Target Areas. This will be particularly important as the projects will be over three counties and will involve multiple Regional Planning Agencies. To maximize transfer of information between regional planning agencies and for the benefit of all Target Area communities, the MA Team will collect, share and refine implementation guidance that will be shared with other regional planning agencies beyond the Target Area.

First, to help communities minimize future damage, flooding, and urban heat island effect, the RPAs will compile and refine lessons learned from the Deerfield River Subwatershed Target Area and in the Springfield Target Area related to planning and designing resilient river crossing such as bridges and culverts, and incorporating green infrastructure, such as street trees, bioswales, and pervious pavement, and other strategies, including alternative roofs and solar. Information will be tailored to meet the various typologies of the municipalities in our Target Areas, for example, larger dense, urban neighborhoods, smaller cities and town, and rural villages.

Next, the RPAs and EEA will develop model local land use planning tools such as bylaws, ordinances, incentives, and regulations, and a river corridor plan for the Deerfield River watershed using the VT River Corridor Management planning guides and models. RPAs will provide direct assistance to Target Area communities, including outreach to local stakeholders and coordination with and assistance to local officials to adopt local land use regulations and river corridor management plans that address site specific conditions in their towns, preclude growth in a floodplain while encouraging communities to develop.

The Massachusetts Department of Public Health (DPH) and Regional Planning Agencies will collaborate on projects implemented through this proposal and on previously developed products and capacity, such as those developed through HUD's Sustainable Communities Regional Planning Grant Program, to create best practices and templates and provide training to the Target Areas on preparing climate change adaptation plans that assess vulnerabilities and make recommendations for municipal and regional actions that will prepare the municipalities for disasters and the impacts of climate change. As a result of their work with vulnerable populations and conducting Health Impact Assessments, DPH and the RPAs understand their

unique needs and challenges in regard to adaptation planning and will include templates and best practices for the communities about how to engage with stakeholders, identify vulnerable populations, understand their needs, and develop effective responses to ensure they are prepared and included in disaster and climate plans. CDC's Building Resilience Against Climate Effects (BRACE) framework and Health Impact Assessment framework may be used to evaluate impacts on vulnerable populations and ensure that the entire community is engaged, informed and empowered through the decision-making process.

The RPAs will also update the data methodology used to complete FEMA-funded local Hazard Mitigation Plans. A revised methodology would streamline the data analysis required for these plans, as well as incorporate climate change data. By broadening the scope of these plans to include expected climate change impacts, these plans will be able to respond to longer-term risks and vulnerabilities and lead to more protective and comprehensive recommendations for action.

Finally, the RPAs and EEA will leverage their experience working on clean energy initiatives to train communities about possible strategies, opportunities, and technologies that can bolster their resilience in the electric, heating and cooling, and transportation sectors.

Budget:

f. Consistency with Other Planning Documents. This rating factor evaluates whether each applicant can provide evidence of consistency with other planning documents.

(Up to 2 points)

Chapter 8 of the Regional Sustainability Plan for Franklin County, *Sustainable Franklin County*, states that the top 3 natural resources goals include protecting forests and protecting drinking water supplies (http://frcog.org/wp-content/uploads/2014/04/Chapter8_NaturalResources.pdf).

Also, the Draft FY2015-2019 Massachusetts Consolidated Plan For CDBG, ESG, HOME and

HOPWA Funds states, “investments in sewer, utility, and road improvements in downtown areas, neighborhoods, industrial zones and underdeveloped rural areas can have dramatic effects on local economies and a cumulative beneficial effect on the overall economy, but many communities do not have the financial capacity to make the necessary infrastructure improvements (p. 36)...CDBG funds may be used for publicly held property. This is most likely in cases of infrastructure and public facility projects like sewer, water and drainage improvements; streetscape improvements; architectural barrier removal; senior centers (p. 80). An example of the guideline “Use Natural Resources Wisely” from the Guidelines for Project Consistency with the Commonwealth’s Sustainable Development Principles is that the project repairs or rehabilitates sewer or water infrastructure to conserve resources (pp. 217-218) (<http://www.mass.gov/hed/docs/dhcd/cd/cdbg/s-111percussiondonotdelete-dhcd-fy15-19conplan.pdf>).

The Regional Sustainability Plan for Hampden County, *Our Next Future: An Action Plan for Building a Smart, Sustainable and Resilient Pioneer Valley* (http://www.pvpc.org/sites/default/files/PV_ACTION_PLAN_TZ_Edit_01_14_2014%20web.pdf), includes the goal to adapt to the consequences of a changing climate and work to increase the resilience of the region’s communities to withstand and recover from extreme weather events and to identify and prepare for likely impacts to the region’s critical infrastructure, and prepare vulnerable people for floods and extreme heat in its Climate Action & Clean Energy Plan (p. 24), goals of elimination or reduction of bacteria, pathogen, and nitrogen loading from combined sewer overflows, prevention of erosion and sedimentation induced by human activity, and promotion of greater public access for Connecticut River recreation and increased use of existing recreational facilities

in its Environment Plan(p. 92), and the goal of promoting and supporting the use of green infrastructure as a cost-effective and sustainable practice for stormwater management in current and future projects including road reconstruction and combined sewer separation projects in its Green Infrastructure Plan (p. 116).

Consistency with Transportation Plan. The 2016 Franklin County Regional Transportation Plan (<http://frcog.org/publication/view/franklin-county-regional-transportation-plan-2016/>) states that MassDOT plans to replace the Trout Brook in Charlemont culvert in a future project. (See p. 13 of Chapter 5: http://frcog.org/wp-content/uploads/2015/08/RTP_Chapter5_Road_Bridge2.pdf.) The Plan also calls for the adaption of transportation infrastructure to climate change by planning for more severe and frequent flooding in the region (Page 11 of Chapter 12: http://frcog.org/wp-content/uploads/2015/08/RTP_Chapter12_Energy-Sustainability.pdf).

Exhibit F – Leverage

Commonwealth of Massachusetts

ExhibitFLeverageMA.pdf

Exhibit F – Leverage

**Link to DropBox/Exhibit F:
(DropBox)**

Exhibit F – Leverage

MA is committed to the recovery of communities from disasters and to strengthening their resilience and preparedness to climate change. Financial commitments of leverage will broaden the reach of our HUD funding to help us meet our resiliency objectives for our Target Areas, through our Direct Leverage and throughout the state, through our Supporting Leverage. See Attachment B for documentation of this leverage, all of which has been firmly committed.

Direct Leverage of \$18,805,943 is firmly committed.

1. EEA’s Greening the Gateway Cities Tree Planting Program

State Fund Commitment: \$2,000,000

Since September 17, 2014, three communities have received financial support for the planting of 1090 trees for a total value of \$901,725. In addition, the Baker-Polito Administration pledged \$1,098,275 in additional spending for Fiscal Year 2016 alone.

2. EEA’s Department Of Energy Resources – Community Clean Energy Resiliency Grant

State Funds Committed in Target Area: \$3,157,409

Since September 17, 2014, a contract for \$2,790,099 was issued for “islandable” and black-start capable combined heat and power facility at Baystate Health, regional hospital in Springfield. A notice to proceed for \$367,310 was issued to the Greenfield High School for

battery storage to complement the planned solar PV system and other equipment to enable the system to island during an outage event.

3. EEA's Department of Energy Resources Pellet Boilers Program:

State Funds Committed: \$5,000,000

This program was announced on December 17, 2014 as an element of the Department of Energy Resources released Alternative Compliance Payment Plan.

4. Massachusetts Department of Transportation Resilience Planning

State Funds Commitment in Target Area: \$626,534

MassDOT has contracted with University of Massachusetts Amherst to conduct an extreme flood vulnerability study of the Deerfield River watershed.

5. Massachusetts Department of Environmental Protection

State Funds Commitment in Target Area: \$8,022,000

Since September 17, 2014, MassDEP has provided funds to the Springfield Water and Sewer Commission to rehabilitate and extend the lifespan of the Dickinson Siphon/Main Interceptor. This will also improve hydraulic capacity which allows for mitigation of structural failure leading to sanitary sewer overflow events.

Supporting Leverage of \$65,402,319 is firmly committed.

6. Energy and Environmental Affairs (EEA) - Dam and Seawall Fund

State Funds Commitment: \$25,520,561

Since September 17, 2014, notices to proceed have been issued to 11 communities for a total current commitment of \$15,434,192. Further, an additional \$10,086,369 in commitment is pending for Fiscal Year 2016.

7. EEA's Office of Coastal Zone Management - Coastal Community Resilience Program

State Funds Commitment: \$3,341,672

Since September 17, 2014, 10 contracts valued at \$1,472,409 have been signed with local communities. In addition, additional awards of \$2,609,958 in awards have been announced to local communities.

8. EEA's Office of Coastal Zone Management - Green Infrastructure Pilot Program

State Funds Committed: \$2,412,562

Since September 17, 2014, 7 contracts valued at \$2,008,837 have been signed with coastal communities. In addition, \$403,725 in awards have been announced to 5 local communities.

9. EEA Direct Grant – Town of Sandwich

State Fund Commitment: \$1,000,000

Announced in September 2015 as a direct grant to the town from a discretionary capital budget for beach nourishment at an eroded dune that allows flooding of homes and the police station.

10. EEA's Department of Energy Resources Reliable Energy for Low Income (RELI) Program

State Funds Committed: \$10,000,000

This program was announced on December 17, 2014 as an element of the Department of Energy Resources released Alternative Compliance Payment Plan.

11. EEA's Department of Energy Resources Municipal Technical Assistance Grants

State Funds Committed: \$455,000

State Funds Committed in Target Area: \$12,500

In August of 2015 EEA – DOER announced grants to 35 communities totaling \$455,000.

Contracts are being finalized at the time of this application.

12. EEA’s Department Of Energy Resources – Community Clean Energy Resiliency Grant

State Funds Commitment: \$22,672,524

State Funds Committed in Target Area: \$3,157,409.

Since September 17, 2014, notices to proceed or awards have been issued to 15 communities for a full total of \$22,672,524.

Exhibit G – Long-Term Commitment

Commonwealth of Massachusetts

Ph2ExhibitGLongTermCommitMA.pdf

Exhibit G – Long-Term Commitment

Phase 2 Factor 5: Regional Coordination and Long-Term Commitment

Phase 1 Long-Term Commitment. Phase 1 long-term commitments on resiliency have been fulfilled since Sept. 17, 2014. Statewide, EEA's DOER invested \$25,829,933 (see Phase 1 Attachment B) in energy resilience, awarding 19 grants including a grant of \$2,790,099 for co-generation to Baystate Health in Springfield, which accounts for 7% of gross regional product generated in Hampden, Hampshire, and Franklin counties supports jobs in nearly 11,000 households (<http://www.baystatehealth.org/Baystate/Main+Nav/About+Us>). Regionally, the regional Tri-Town water supply serving Braintree, Randolph and Holbrook borrowed \$814,671 at 2% interest and received a grant of \$185,329 from EEA to reconstruct and fortify infrastructure at the Great Pond Lower Reservoir Dam, protecting the water supply of 77,500 residents and demonstrating a strong commitment toward resilience regionally. Locally, Bellingham, Canton, and Gloucester each borrowed between \$312,000 and \$853,600 from EEA's Dam and Seawall Repair or Removal Fund to reconstruct a water supply dam or remove a deteriorated dam, preventing flood danger. Gloucester's dam repair protected 60 townhouses of Gloucester Housing Authority, a water treatment plant, and 644 students at a middle school.

Lessons Learned: New England States Collaboration. In November 2013, climate leaders in state government and in the non-profit community in the six New England states attending the EPA's Climate Leaders Summit identified the need to create a formal network to ensure collaboration across state to share best practices, advocate with federal agencies, obtain funding, and provide continuity at the agencies (LINK TO BIG IDEA B CONCEPT PAPER). Over the

next year, EPA and the state agencies participated in several conference calls to determine the structure and mission of such a network. The Institute for Sustainable Communities obtained a grant from Jane's Trust to facilitate the development of the New England States Climate Resilience Collaborative. ISC is researching local, state, and federal regional climate activities and needs; convening the states in a workshop and conference call; and identifying and supporting shared funding priorities. MA has been participating in the collaborative since it was formally established in April (link to ISC MOU).

Lessons Learned: MBTA Winter Resiliency Plan. It was the Great Blizzard of 1888 that led city officials in Boston to construct the country's first underground transportation system (<http://wgbhnews.org/post/video-boston-versus-new-york-how-1888-blizzard-launched-subway-rivalry>). This irony was not lost on Bostonians who, during the winter of 2015, endured the melt-down of their regional subway system, which was closed or provided only partial service for several weeks. In June, Governor Baker and MassDOT announced a plan for investments this summer and over the next five years in snow removal equipment and infrastructure upgrades to improve winter service reliability. The \$83.7M resiliency plan, developed based on recommendations by an American Public Transportation Association peer review of the MBTA's winter operations, will provide particular relief to the riders of the MBTA's Red and Orange Lines, which in 2013 had 217,329 and 159,220 annual entries, respectively (pp. 21, 33 of <http://www.mbta.com/uploadedfiles/documents/2014%20BLUEBOOK%2014th%20Edition.pdf>)

Lessons Learned: Environmental Justice. EEA issued the state's first Environmental Justice (EJ) Policy in 2002. In November 2014, the Governor issued an Executive Order requiring EEA

to update its EJ Policy and creating a new position and an Advisory Council to advise on EJ policies and practices. EEA released a public review draft of the EJ Policy and hosted six listening sessions throughout the state to receive comments (<http://www.mass.gov/eea/grants-and-tech-assistance/environmental-justice-policy.html>). Proposed updates to the policy include a new definition of Environmental Justice, “the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of energy, *climate change*, and environmental laws, regulations, and policies and the equitable distribution of energy and environmental benefits.” The updated policy will include a new emphasis on climate change, targeting EEA resources to service those high-minority/low-income neighborhoods in MA where the residents are most at risk of being unaware of or unable to participate in environmental, energy, or climate change decision-making. The policy directs EEA “to ... appropriately address climate change ... by enhancing opportunities for residents to participate in ... climate change decision-making; ensuring that residents are prepared for and resilient to the effects of climate change (such as heat island effect or flooding) and ensuring that these effects are minimized during development; ensuring that existing facilities in these neighborhoods comply with state ... climate change rules and regulations; and assist with compliance with climate change regulations.” This policy could benefit 137,083 people (89.6% of the population) in Springfield and 2.2M people (46.6% of the population) statewide (“2010_EJ-municipal_stats.xls” of <http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/cen2010ej.html>).

Legislative Action: Senate Bill 451. In July 2015, the MA State Senate passed *S.451 An Act providing for the establishment of a comprehensive adaptation management plan in response to*

climate change (CAMP) filed by Senator Marc Pacheco. This is identical to H.752, a bill in the State House of Representatives filed by Representative Frank Smizik. This legislation would result in establishment of an adaptation management action plan through a collaboration led by EEA and the Executive Office of Public Safety and Security; compilation of data on existing and projected sea level rise using best available science; production of a report documenting the preparedness and vulnerabilities in the Commonwealth's emergency response, energy, transportation, communications, health, and other systems; and establishment of an interagency advisory committee supported by technical subcommittees and staff to carry out the plan. It would also establish grant program to provide financial assistance to regional planning agencies for the development and implementation of the plan and establish a coastal buyback program to acquire by voluntary purchase properties repeatedly damaged by severe weather.

Raising Standards: Updated MA Building Code. In June, 2015 the Board of Building Regulations and Standards (BBRS) approved a draft of the 9th Edition of the State Building Code (780 CMR), which is based on the 2015 International Building Codes, with some overlaying Massachusetts-specific amendments. The 9th Edition of the State Building Code will be released this fall for public comment and builds on revisions made in 2008 that require proposed or substantially renovated buildings/structures in coastal high-hazard zones ("V Zones") as delineated by Federal Emergency Management Agency (FEMA) be elevated 2 feet above the base flood elevation (<http://www.mass.gov/eopss/consumer-prot-and-bus-lic/license-type/buildings/draft-9th-edition-of-the-building-code-approved-by-bbbs.html>). FEMA's Flood Insurance Rate Maps depict zones indicating the predicted magnitude and severity of flood hazards in a 1%-annual-chance flood ("100-year flood"). The "V Zone" is the area subject to

wave heights in excess of 3 feet or to high-velocity wave run-up or wave-induced erosion. The “A Zone” is the area projected to flood with wave heights less than three feet. The “Coastal A Zone” is the portion of the A Zone in coastal areas that is subject to wave heights between 1.5 and 3 feet—wave heights that can cause significant damage to buildings. Post-disaster assessments have demonstrated that waves 1.5 feet in height or greater can cause significant damage to buildings. For the 9th edition of the State Building Code, Massachusetts is proposing to adopt the 2015 Edition of the International Building Code, that including requires new or substantially improved buildings in Coastal A Zones be built to the V Zone standards. The Code also would give authority to the local Conservation Commissions to set the elevation of the lowest floor in coastal dunes. The BBRs states that expects that the new code to become effective during the first quarter of 2016. There are 192 miles of general coastline and 1,519 miles of tidal shoreline that will benefit from this change.

Raising Standards: MA Environmental Policy Act. MEPA requires state agencies to study the environmental consequences of their actions, including permitting and financial assistance and to take all feasible measures to avoid, minimize, and mitigate damage to the environment by studying alternatives to the proposed project, and developing enforceable mitigation commitments. In Dec. 2014, EEA proposed for public comment the MEPA Climate Adaptation and Resiliency Policy and Protocol under the authority of the Global Warming Solutions Act of 2008 (GWSA) (Chapter 298 of the Acts of 2008) and the MEPA statute (M.G.L. c. 30, §§61-62I). The GWSA requires, “In considering and issuing permits, licenses and other administrative approvals and decisions, the respective agency, department, board, commission or authority shall

also consider reasonably foreseeable climate change impacts, including additional greenhouse gas emissions, and effects, such as predicted sea level rise” (LINK).

Resilience Action Related to Plan Alignment. EEA and PVPC received a grant from the U.S. Forest Service and have begun planning and designing street-scale stormwater tree installations in Springfield, Chicopee, and Holyoke. These Gateway Cities have among the highest poverty levels and lowest median income of any cities in MA and Holyoke and Springfield are ranked in the top two priority tiers for Priority Urban Forests in the 2010 *Forest Resource Strategies of Massachusetts* (page 50, <http://www.mass.gov/eea/docs/dcr/stewardship/forestry/massachusetts-forest-resources-strategies.pdf>). The tree installations will be designed to reduce stormwater runoff and pollutant load to combined sewer systems and act as demonstration projects to other New England mill cities. Green alleys or streets, rain barrels, and tree planting are estimated to be 3-6 times more effective in managing storm-water per \$1,000 invested than conventional methods. In Houston, Texas trees provide \$1.3 billion in stormwater benefits (based on \$0.66 /cubic foot of storage) ([http://ccap.org/assets/The-Value-of-Green-Infrastructure-for-Urban-Climate-Adaptation CCAP-Feb-2011.pdf](http://ccap.org/assets/The-Value-of-Green-Infrastructure-for-Urban-Climate-Adaptation_CCAP-Feb-2011.pdf)). With the three cities making up 53,000 acres of 254,000 residents, this is truly a landscape-scale urban forestry project. This "Urban Tree Planting" project is consistent with the Pioneer Valley Green Infrastructure Plan (<http://www.pvpc.org/sites/default/files/PVPC%20Green%20Infrastructure%20Plan%20FINAL%2002-18-14.pdf>).

Financing and Economic Resilience Action: Seaport Economic Council. In July 2015, the Baker Administration established the Seaport Economic Council to provide economic support to

the state's 78 coastal municipalities and their business partners. The council expects to provide infrastructure, economic planning, and educational grants, investing \$16.5 million in this fiscal year. Best available science and information regarding potential threats to coastal communities from sea level rise and extreme weather events will be used to evaluate proposed projects to ensure that the council's investments improve sustainability and resilience

(<http://www.mass.gov/governor/administration/groups/seaporteconomiccouncil/programoverview/>).

2,174,863 people of the state's total population of 6,605,058 (32.93%) reside in coastal communities and could potentially benefit from investments made by this council.